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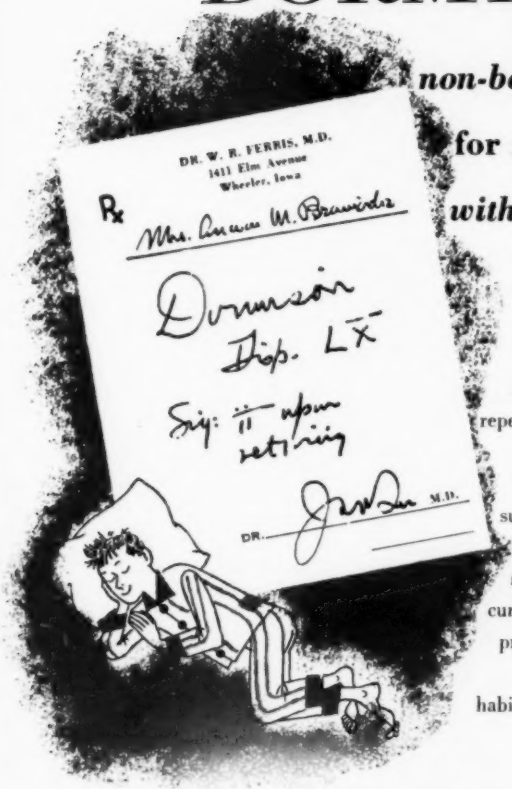

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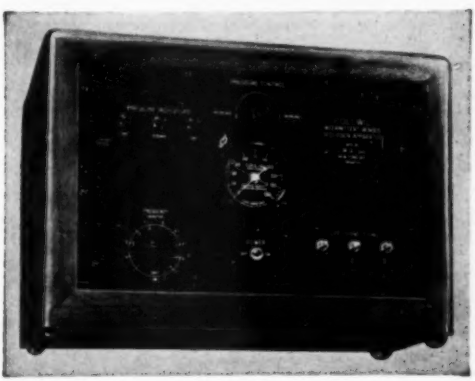

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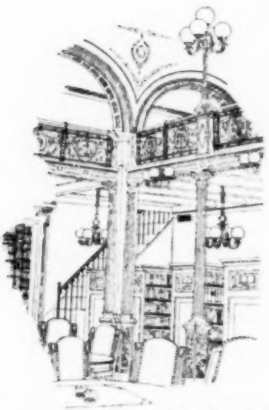

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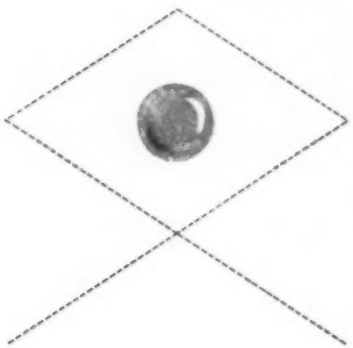

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ROBERT L. CRAIG, *Editor*

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VOL. 28, NO. 4 APRIL 1952

THE LIBRARY OF THE NEW YORK ACADEMY OF MEDICINE*

JANET DOE, *Librarian*

The New York Academy of Medicine

"Dr. SMITH speaking. Is this the Library? Can you help me? I've got to do a talk on ectopic pregnancy next week. I've most of the main data already, but I need more of the background material. If I come up there tomorrow morning, can you get it out for me? I'd like to know such things as: who first described it, who first discovered the cause, who did the first recorded operation for it in this country, who was the first to suggest laparotomy as the only effective treatment, and who first had the courage to follow out that suggestion. Do you think you can get that? Good! Then I'll need besides that a few statistics: what's the comparative mortality between operated and unoperated cases; how often can an ectopic pregnancy be expected among normal ones; what is the most frequent type.—Oh, and if there is a good all-around recent article about it, one that covers all the main points, I'd like to have that too. Is that too big an order? No? Fine, I'll be there in the morning."

That is one end of an imaginary conversation whose other end may

* Based on a radio talk over Station WNYC-FM, under the auspices of The New York Academy of Medicine, November 15, 1951, 9-10 P.M.

be heard in the Academy Library day after day. The answers to these, or to any other sorts of queries on which a physician under pressure needs help, are to be found there. How many New Yorkers realize that they have on their doorstep one of the most extensive collections of medical literature, for the free use of any and all who have a legitimate need? Medical books, and especially medical journals, are the staff of life to the progressive medical man and woman. That fact was well recognized a century ago when in 1847 the founders of the Academy united to maintain the ethics of the medical profession on a high level and to support a medical library. Their broad foresight permitted the use of their books not merely to their own fellowship, but to all who needed them. They knew then, as we do now, that medical knowledge which is not constantly refreshed soon stagnates, and that the whole medical profession, not just a private segment, requires regular access to new knowledge. Seldom could a physician afford to buy all the books he needed. The solution lay in a pooling of individual funds and libraries to form one good collection from which all could satisfy their needs. Growing slowly at first, the Academy's little group of volumes waxed from a few hundred volumes to a few thousand. Then an occasional large gift stimulated others,—the first such major donation was that of Dr. Samuel Smith Purple in 1875—and when once a sizable collection was established, it attracted further legacies and donations. The Medical Journal Association turned over its accumulation; the Mott Memorial Library and the New York Hospital Library, one of the largest and best stocked in the city, were deposited here. Innumerable physicians gave their large and small stocks to swell the total down through the years. By the turn of the century, 50,000 volumes had been accumulated, and the New York Public Library began to rely upon this institution to meet the needs of the medical public instead of building up its own medical collection, capping its trust in this respect two years ago by making over to the Academy Library all of the medical books, some 22,000 of them, it had hitherto acquired. Thus, to all intents and purposes, this Library serves as the public medical library of New York City. And this it is glad to do, for it has received much from individual New York citizens and institutions, even though it is privately supported and receives no public funds.

What does this long continued gathering of medical books amount to? It's not just a conglomeration of thousands of musty tomes—dusty

though some of them may be, alas. It is two things: first, a living, working collection of the new and vital accretions to medical knowledge, drawn from all over the world where scientific medicine is advancing; and second, it is a vast reservoir of the major and minor additions down the years, among which students, scholars and research workers, can find those out-of-the-way papers which often furnish the missing bricks for the foundation of new knowledge. This last function, that of the comprehensive research collection, is, for certain, one of its most important contributions. There are many other working medical libraries in New York City, sixty or so, at least,—every live medical institution of any size must have one of sorts—but the broadly based reference library possessing seldom called for but occasionally indispensable reports is a necessity for a medical research center such as New York has become. The practitioner and the research worker must have at hand the important records of their profession.

What makes up this record? First, of course, the current journals, all of any importance, and the older ones, most of them from the beginning of their existence, for the periodical literature contains the main meat of all modern sciences. Then come the textbooks and special monographs with the summation of knowledge on a given topic. Primary source materials such as case histories, hospital reports, government documents, and statistical records often furnish the solution of a particular problem. Students' doctoral dissertations may provide the germ of a valuable idea; long files of medical school announcements may show the development of medical education and point the way to improved methods of teaching. The transactions of national, and notably of international, congresses, bring together the ideas of leaders of the profession and its specialties. All types of compilations by medical men and allied scientists are gathered here to form a rich mine of information.

One doubtless expects that these deal mainly with the medical field. Far from it: that of course forms the nucleus of our literature, but there is an ever widening periphery of adjacent fields which must be included in some degree. These are: the basic disciplines, anatomy, physiology, pathology, pharmacology; the substance of the allied professions, dentistry, nursing, pharmacy, veterinary medicine, sociology, anthropology; the general sciences, chemistry, physics, botany, zoology; and lastly, the cultural aspects of medicine, its history, biography, bibliography, its relations to art, music, and literature. When we consider all these

ramifications from the main root of medicine, it is small wonder that they cannot be exhaustively covered even by the 277,000 volumes in the Academy Library. But they are adequately represented here. Practically all of the important up-to-date literature is present, as are most of the vital publications issued in the nineteenth century, and a great deal from the centuries before that, not only those in English but in foreign languages too: German, French, Italian, Spanish, Scandinavian, Dutch, Central European, Slavic, and not a few from Asia and Africa. It is the aim of this Library to provide, as far as its resources permit, all of the worthwhile literature pertinent to medicine, new and old.

Who is privileged to consult it? Every serious minded adult who has reason to. Its facilities are naturally directed primarily to medical workers, and about half its clientele consists of physicians. The other half is drawn first from members of the related professions, dentists, nurses, pharmacists, veterinarians, social workers, college and university faculties and students, hospital staffs; the business world contributes some, advertisers, drug houses and insurance companies; writers in many fields find their grist here, abstractors for scientific journals, newspapermen, novelists, magazine-writers, dramatists, composers of radio and movie scripts, and even poets; and the sister professions of theology and law not seldom make use of these medical sources.

The mass of inquiries coming to the Library covers all imaginable topics. Most of them, of course, concern medicine, but many go far afield. "Who publishes Howell's *Physiology*?" "What are the laws relating to anatomy in the United States?" "What books are there written for people with heart disease?" Examples of less usual questions are: "When were cotton sutures first used in surgery?" "What is the total floor space of all the operating rooms in the United States?" "What famous people had epilepsy?" And then there are the extraordinary queries, such as: "How many women in the United States are bald?" "How many taxi-drivers in New York have gastric ulcers?" "Did Anne Boleyn have six fingers on one hand?" We try to run down the answers to all reasonable inquiries, but, as we said, the Library exists first and foremost for the physicians. Their needs are what it is designed to meet and towards which its major energies are spent.

What can a medical man get in the Academy Library? If he can come to the Library himself, he will get the most satisfactory results. Reference Assistants will do all they can to help him find the informa-

tion he wants: they will show the way through the mazes of the card catalogue; they will explain the intricacies of the various indexes to medicine and the specialties – and there are many! They will give him the benefit of the short cuts they have learned, and above all, they will do their best to unravel that wrong reference that is forever turning up. With their help – or without it if he prefers – he can dig out a single vital point that is holding him up, or he can gather around him just about everything of note that has ever been compiled on his subject – the differential diagnosis of an ectopic pregnancy, perhaps – and he can absorb it in comfort. If some of the books or articles are in a language unfamiliar to him, the Bibliographical Department can make abstracts or full translations, – though it does *not* abstract from English – or it can read out specified passages orally. If he can possibly bring his problem to the Library in person, he will be better able to explain it and the staff to give assistance.

If, however, it is not possible for him to come here, questions can be answered by mail or telephone, as far as the latter serve. Long or complicated queries are better dealt with on paper than by phone, and *very* long ones have to be handled by the Bibliographical Department at a fee, since the demands on the Reference Staff do not permit their dealing with matters requiring long research. Besides the help with foreign literature already mentioned, this Department makes up bibliographies on any requested subject, or checks from the original sources one already made and puts it in proper form for publication. It also edits manuscripts – but does *not* ghost-write! – and gives any reasonable sort of bibliographical assistance. One most useful service is that of keeping watch of the current journals daily for articles on any given topic in which a person may be interested. For a nominal monthly fee, plus an even more nominal sum for each reference found, it will send him each month references to all the articles which come out on his topic in the 2500 periodicals regularly received in the Library. Thus an individual can easily keep abreast of new data on ectopic pregnancy or twins or natural childbirth or whatever he most wants to know about, without having to go over all the publications himself.

There are other ways the Library can be useful if a person can't come to it. If one lives outside New York City, his local library can borrow books for him, though the Library cannot lend to him directly as an individual. The library does not have to be a medical one: any one

will do, public, university, hospital, or whatever it may be, so long as it is a non-profit agency. All the inquirer has to do is have his librarian ask the Academy Library on his behalf for information about its interlibrary loan regulations, in order to procure any of our books or journals which are allowed to go out, – and most of them are. Fellows of the Academy, of course, can borrow books directly, whether they are in New York City or elsewhere, and so can individual subscribers making a specified contribution. Anyone interested should ask for the details of this arrangement.

Often, however, one wants books or articles for longer periods than loans will permit. In this case, photostats or microfilm can be made, usually at not too great cost. If illustrations are required, such as a diagram of the valves of the heart, for instance, or a picture of the discoverer of insulin, one can order a photostat or a lantern slide. Special order-forms for these are necessary which will be sent on request.

Perhaps one wants something besides present-day practical advice. If it should be historical data – for instance, the first reasonable explanation of an aneurysm, – one would find in the Rare Book and History Rooms of the Library various histories of vascular diseases, and one could see there the 1728 Latin text of Lancisi's classical account, *De Aneurysmatibus*. If one needs a portrait of that author, there is a beautiful engraving in his book from which a photograph could be made. Or if a signature of Samuel Bard, Washington's personal physician, was wanted, it could be had.

Perhaps one's interest concerns physicians who have made their mark in other fields than medicine: novelists or poets, sculptors or painters, musicians or geologists. Here in the Library will be found the works of Conan Doyle, Charles Lever, Anton Chekhov, and the poems of William Carlos Williams and Merrill Moore. Here, too, are examples of drawings by Robert L. Dickinson, engravings by Alexander Anderson, and reproductions of Tait MacKenzie's sculpture. Further, an extensive card-list of the medical men who have written in the literary field can be consulted. The collection is particularly rich in biographical material of all sorts, not only a great number of collected and individual biographies, but thousands of portraits and all sorts of memorabilia: medals, commemorative postage stamps, autograph letters, diaries, and diplomas.

Besides this sort of material, the Library has a remarkable collection

in an unexpected field, one of the most comprehensive gatherings of books on foods and cookery to be found in this country. The late Dr. Margaret Barclay Wilson presented to the Academy her large accumulation of these culinary classics and kitchen guides from all over the world and in all languages, starting with a beautiful 9th century manuscript on parchment and coming down to Fanny Farmer's standard text.

Speaking of this gift of Dr. Wilson's takes us back to the way this Library has grown. Much of its store has come from the libraries of doctors whose own education and practice have been built on the knowledge in the books which they have generously passed along to this center of literature. And these books mean twice as much for having done good service already. Perhaps someone has choice volumes which he would like to see in a safe place where others can enjoy and use them, or his library shelves need weeding in order to make room for newcomers. Old or recent, many or few, the medical books for disposal will be welcomed in the Academy Library, either to fill gaps in the collection or to be passed on to other libraries which need them, or there may be other things besides books for which a good resting-place is wanted, – pictures of doctors or of medical institutions, diplomas or certificates, commemorative medals, or old medical instruments or apparatus. One service sometimes particularly appreciated is the preservation by the Library of the minutes and private records of medical societies or institutions. Any organization wishing to take advantage of this may deposit its archives here, either as a gift or on loan, and may specify to whom they are to be made available: only to their own officers or members, or to the general public. All such things will help to round out the Academy's collections. If they cannot be sent in, arrangements can in some cases be made by telephone for collecting them.

More details about what the Library has and does are contained in a set of Information Circulars which were published in the March, 1951, issue of the Academy's *Bulletin*, and copies will be sent to anyone who asks for them. This Library was built to be used. The reading rooms are open to everyone Monday through Saturday from nine in the morning to five in the afternoon. The staff is trained to help physicians work out their literary problems. Why not bring these to the Academy Library?

THE ROLE OF THE CONNECTIVE TISSUE IN DISEASES OF THE CARDIOVASCULAR SYSTEM*

PAUL KLEMPERER

Pathologist, Mount Sinai Hospital, New York

CONNECTIVE tissue fundamentally participates in the construction of the cardiovascular system. It is obvious that in a discussion of morbid states of this system serious consideration must be given to the role played by the connective tissue. For instance the valvular deformities characteristic of chronic rheumatic heart disease, or the intimal changes of arteriosclerosis are the result of an abnormal overproduction of connective tissue substance. Textbooks refer to inflammation as the cause of the former, to metabolic disturbances as effective in the latter. But such general pathologic explanations give no account of the intrinsic biologic and chemical mechanisms which operate to produce an increase of connective tissue substance. An understanding of the cardiovascular alterations must rest upon a comprehension of the basic factors which are responsible for the imbalance of growth of the connective tissue, which means that interest in diseases of the cardiovascular system necessitates a consideration of the connective tissue problem.

What is the problem? Divested of all the secondary questions of cellulation, which have attracted the attention of biologists for more than a century, it is the relationship between the cells and the intercellular substances. The problem did not exist before the discovery of the connective tissue cell by Schwann,[1] because previous investigators (Haller) had considered the fiber as the only elementary constituent. The recognition of two or more components, cells, fibers and a homogeneous intermediate substance, necessarily led to the question of their genetic relationship. While Schwann[1] and Henle[2] believed that cells and intercellular substances develop from a formless, mucoid cytoblastema, the ancestral form of the living substance, Reichert and Virchow[3] proposed the primacy of cells. Schwann[1] assumed that fibers develop

* Read at the Graduate Fortnight of The New York Academy of Medicine, October 19, 1951. From the Department of Pathology, Mount Sinai Hospital, New York, N. Y. Supported by grants of the Life Insurance Medical Research Fund and the U. S. Public Health Service.

in the connective tissue directly from the cells, while Henle[2] believed that the residual original cytoblastema also gave rise to fiber formation. Reichert and Virchow[3] maintained that the cells alone can form fibers, though not by a transformation of the cytoplasm but through the formation of a secretion which subsequently undergoes fibrillation. Accordingly Virchow[3] postulated that the intercellular substances were not endowed with vital activity. Schwann's[1] and especially Henle's[2] original theory is today of historical interest only because the idea of a primordial formless cytoblastema became untenable with the discovery of cellular division as the universal form of organic development, clinched by the famous pronouncement of Virchow:[4] omnis cellula e cellula. However, the belief in an independence of the intercellular substances from formation by local cells to which Henle[2] subscribed though based on an erroneous conception, retained its validity and has been supported by subsequent investigations. In fact, the origin and source of the intermediate substances of the connective tissue seems to me, to be one of the most crucial problems of modern pathology.

Contemporary investigations of the connective tissue were dominated by Virchow's doctrine of the primary importance of the cells and the intermediate substances were stripped of biologic significance. Only the cells were capable of irritation, of metabolism and of reproduction. According to Virchow, they were endowed not only with a great power of proliferation but also capable of almost universal transformation. They formed a sort of germinal layer which gave rise to all the cells of the inflammatory territory and to many neoplasms. While this exaggerated importance of the cells of the connective tissue was successfully challenged by Cohnheim[5] and his school and by Thiersch,[6] Waldeyer[7] and others, the intercellular substances continued to exist in their neglected role as a material formed for the one purpose only, to fill in and to support the nobler elements of the human body. Only Stricker and Grawitz tried to give biologic dignity to the intercellular substances by proposing that they could revert to connective tissue cells. This hypothesis takes its origin from Schultze's and Flemming's[8] beliefs that the connective tissue fiber is not the product of a secretion of the connective tissue cell (the later fibroblast) but of a transformation of part of its cytoplasm, which Hansen[9] subsequently called the ectoplasm. This theory gained more and more momentum through the publications of Studnicka[10] and Wassermann.[11] It was introduced by Hueck[12] into the

interpretation of pathologic states affecting the connective tissue, specifically for the explanation of arteriosclerosis. According to this theory, the cytoplasm of the cells of the mesenchyme primarily form an interconnected syncytium. The perinuclear cytoplasm, referred to as endoplasm, is the metabolically most active part from which in its further development an outer layer, the ectoplasm, becomes demarcated. This metabolically less active outer layer of the undivided cytoplasmic syncytium is transformed into the extracellular ground substance of the mesenchyme and develops fibers. The fibrillar differentiation is to be considered as a vital, structure forming process because the ectoplasm is still endowed with some, though reduced, vitality. Cells and fibers remain genetically united and represent the living matter in its totality. This concept of the relation between cells and extracellular substances is based upon investigations of human embryonal and adult connective tissue supplemented by studies of lower forms of animals.

The alternative theory regards the intercellular substances as a secretory product of the connective tissue cells. As mentioned before, this concept originated with Virchow, was fully accepted by Koelliker and subsequent investigators and is still recognized by the majority of histologists (Stearns).[13] Virchow[3] was aware of the ectoplasm theory, first promulgated by Schultze. It is of more than historical interest to refer to his statements in refutation. He believed that the discussion whether fibers originate from cellular secretion or from a metamorphosed cytoplasm was only an academic argument. "Because the concept of a secretion of the intercellular substance takes it also for granted, that the secretory product originally was contained within the cell . . ." and "nobody has yet demonstrated that the cortical layer of the connective tissue corpuscles is actually transformed into intercellular substance." One can add that conversely no irrefutable proof has yet been supplied either for a secretion of the intercellular substances by the connective tissue cells. This state of our information makes it necessary not to neglect the original idea of Schwann[1] and Henle,[2] who thought of deposition of intermediate substances independent of connective tissue cells. Baitsell[14] was the first to use the dynamic method of tissue culture for the investigation of fiber formation and came to the startling conclusion that collagen fibers can be formed without the interaction of fibroblasts. Because he postulated a transformation of fibrin into collagen fibers and because the newly formed fibers were not

resistant to trypsin digestion, Baitsell's far reaching conclusions were generally not accepted. However, the belief in an extracellular formation of collagen fibers found forceful support by the investigations of Maximow[15] and his school and a great number of subsequent students of tissue cultures. Their conclusions were finally clinched by the studies of Porter and Vanamee[16] who showed that the fibers formed in cultures of fibroblasts of different vertebrate species showed characteristic periodicity under the electron microscope and that they resisted trypsin digestion.

Yet even these brilliant results of in vitro experiments have not solved the fundamental connective tissue problem. The relationship between fibroblasts and intermediate substances of the connective tissue in vivo is still obscure because we do not yet know enough about the interaction between cell and medium in vitro. Porter,[17] in recent, not yet published, studies found that fibroblasts cultured in protein-free Locke's solution can form fibers, but that fiber formation is accelerated and augmented upon addition of plasma. The question is raised again as to the relative importance of the living cell and the lifeless ground substance of the tissue culture. This is the first problem which underlies the riddle of the diseases characterized by abnormalities of the connective tissue. In vitro experiments seem to leave no doubt that fibroblast and collagen fiber formation are intimately bound together. Accepted school doctrine postulates the same for the living organism. Yet there are facts, not so widely known, which contradict the conventional belief of an exclusive genetic relationship between the mesenchymal cell and collagen fiber. Von Ebner[18] as long ago as 1896 demonstrated that collagen fibers develop in the notochord sheath of lower fish without the presence of mesenchymal cells. Reed and Rudall[19] demonstrated the presence of fibers with the characteristic x-ray diffraction pattern of collagen within the ectoderm of the earthworm, although they did not show the periodicity under the electron microscope. These disclosures indicate that the material necessary for collagen fiber formation is not supplied exclusively by cells of mesenchymal derivation. Nageotte[20] in his classical book categorically denied the origin of the collagen fibers from fibroblasts. According to his opinion they are formed by precipitation from the albuminoids of the milieu internal of Claude Bernard, i. e., from the universal body fluids. That fibers can develop from a colloidal medium under the influence of mechanical forces had already been

shown by von Ebner. It remained for Nageotte[21] to demonstrate that collagen fibers can be precipitated from a cell- and fiber-free acid solution of collagen by neutralization or addition of salt. His observations were confirmed and further expanded by Huzella[22] and his associates who showed that fiber formation from a homogeneous solution of collagen is under the exclusive control of physicochemical forces. In ingenious in vitro experiments he succeeded in producing fiber frameworks whose architecture simulated that of various organs and tissues of the living organism. These artificial fiber systems could be populated by bringing them in contact with living heterogeneous cells in tissue cultures. F. O. Schmitt and his associates[23] could show that the fibers precipitated from an acid solution of rat tail collagen have the characteristic periodicity of collagen fibers under the electron microscope. In recent experiments (Highberger, Gross and Schmitt[24]) it was demonstrated that through interaction of pro-collagen and plasma mucoprotein collagen fibers are produced. Therefore there is evidence that collagen fibers can develop without the intervention of specific cells. Nageotte[20] and Huzella[22] deny the existence of a genetic relationship between intermediate substances and connective tissue cells and maintain that the material necessary for their formation is derived from the tissue fluids which in turn receive their contributions from the metabolism of the entire body. While this contention has not been proven it is well to remember that the formation of the intercellular substances by the fibroblasts has never been unequivocally demonstrated either. In the present uncertainty it seems advisable to refrain from the premature interpretation that quantitative or qualitative abnormality of the intermediary substances of the connective tissue invariably denotes abnormality of the fibroblast.

It is for the same reason that I prefer the term "collagen disease" (Klemperer, Pollack and Baehr[25]) with all its admitted inadequacy, to the apparently conciser term connective tissue or mesenchymal disease with its cellular pathologic connotation. The term "collagen disease" was originally proposed because pathologic-anatomic observations had convinced us that in certain maladies generalized alterations of the intercellular substances were the striking morphologic features and therefore of pathogenetic significance. Rheumatic fever belonged to this group, as well as polyarteritis nodosa among the diseases of the cardiovascular system (Klinge[26]). But our attention was drawn to the intercellular substances of the connective tissue by histologic investigations of systemic

lupus erythematosus.[27] Because cardiovascular alterations are very common in this disease it might be permissible to refer to observations in this malady to illustrate the role of the connective tissue in cardiovascular diseases. We were first impressed by widespread fibrinoid alterations of this tissue, and according to prevailing opinion, we considered them as an alteration of the collagen fibers. This was erroneous and in subsequent reports I have avoided reference to the collagen fibers as the seat of the connective tissue alteration. My own observations agree with the findings of Altshuler and Angevine[28] that the fibrinoid material is deposited between the collagen fibers within the ground substance. Fibrinoid connective tissue damage has been prominently featured by Klinge as a significant lesion in rheumatic fever. In fact it has been singled out by him for his pathogenetic interpretation. The occurrence of similar connective tissue changes in hypersensitive animals led him to the biologic-anatomic synthesis that maladies anatomically distinguished by fibrinoid connective tissue damage were of allergic background. This hypothesis has found widest acceptance all over the world; it has been championed by Rich[29] in this country. We did not agree with the sweeping generalization. I have repeatedly detailed the reasons for our disagreement and do not want to repeat them.[30] But one of the reasons which I should like to emphasize was my doubt in the identity of the materials called fibrinoid which were found in so many heterogeneous diseases. In 1947 in a lecture[31] from this platform I concluded that "it still seems necessary to inquire whether the apparent identity of fibrinoid collagen in such heterogeneous situations might not be a delusion."

It is generally agreed upon that fibrinoid connective tissue change is one of the conspicuous features of the pathologic-anatomic picture of systemic lupus erythematosus. For years I have attempted to identify this material. In 1941 we[27] demonstrated that the glomerular wire loops and the hyaline thrombi within their lumen which stain identically were digested by trypsin. This proved first that they were of proteinic nature but not identical with collagen. In later years Dr. Feitelberg of our Physics Laboratory by wide angle x-ray diffraction examined endocardial vegetations in this disease which, we believed, originate from intravalvular fibrinoid deposits. It was shown that they did not contain collagen; the x-ray diffraction pattern was that of a mixture of proteins but not characteristic. Recent investigations, carried out by Drs. Gueft and Laufer[32] at Mount Sinai, and the Fairfield State Hospital, have thrown

light upon the origin and nature of the fibrinoid substance deposited within the wall of glomerular capillaries and of arteries. These studies took their origin from our old observations[33] of hyaline thrombi within the glomerular capillary lumen and our recent analysis of the hematoxylin bodies.[34] It was noted that some of the homogeneous eosinophilic plugs showed smudged particles stained with hematoxylin. These particles were Feulgen positive and could therefore be identified as desoxyribose nucleic acid. It was thus suggested that they were the remnants of a progressive depolymerization of the DNA and that the major part of the hyaline thrombi consisted of the protein moiety of the nucleoprotein. In order to test these deductions appropriate histochemical determinations were carried out. The hyaline thrombi and wire loops are digested by trypsin; they are Millon positive, strongly absorbing the light of a mercury vapor lamp of 3650 A wave length. This proves the presence of tyrosin containing protein. The non-histone protein is such a compound. According to White[35] histone stains strongly with orange G if submerged in a mixture of aniline blue and orange G at p.H. 3. The hyaline thrombi and wire loops stain selectively yellow under such circumstances. The results of the histochemical studies therefore support the assumption that the hyaline thrombi are the products of a progressive degradation of nucleoprotein of which the hematoxylin bodies represent an earlier phase. Since the wire loops stain identically with the hyaline thrombi within the capillary lumen the conclusion seems justified that they consist of the same material which has impregnated the basement membrane. The fibrinoid of larger vessels is tinctorially identical with that of the glomerular capillaries and is always mingled with hematoxylin-stained bodies. Its chemical nature and origin is therefore most likely the same. The conclusion is then warranted that the vascular fibrinoid in systemic lupus erythematosus is the product of the peculiar disturbance of nucleic acid metabolism which is, according to our studies, specific for the malady.

These observations further indicate that the connective tissue changes, commonly designated as fibrinoid, must not be considered to be of identical nature. It is evident that the fibrinoid alteration in systemic lupus erythematosus, which is the product of a pathogenetic mechanism specific of the malady, cannot be identified with fibrinoid connective tissue changes in other diseases in which this mechanism is absent, although the inadequacy of our conventional histopathologic

technique and method of investigation suggests similarity. The popular generalization that fibrinoid alterations of connective tissue denote hypersensitivity is challenged by our observations just as much as the more recent generalization of a hyalinosis or collagen disease syndrome due to hormonal imbalance.

In my introductory remarks I have referred to the uncertainty which still prevails in regard to the problem of the origin and source of the intermediate substances of the normal connective tissue. The fibrinoid substance plays an important role in the pathologic-anatomic definition of the so-called collagen diseases, and many of the maladies which can be included in this collective group are characterized by cardiovascular implication. Fibrinoid certainly is an abnormal component of the intermediate substances of the connective tissue. Its derivation from collagen fibers has become very doubtful indeed. One of the principal results of our recent studies of systemic lupus erythematosus is not only the recognition of its specific nature in this disease but also that it is derived from degradation products of nucleo-proteins which are circulating within the blood. This relation between abnormal constituents of the blood plasma and vascular connective tissue changes seems to me of more general significance and worthy of further investigations.

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THE TREATMENT OF SOME BACTERIAL INFECTIONS OF THE HEART AND PERICARDIUM*

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PURULENT pericarditis is rapidly becoming a medical curiosity. Infections of the pericardium by pyogenic organisms used to be a fairly common accompaniment of severe uncontrolled infections such as pneumococcus pneumonia, staphylococcus septicemia, meningococcemia and the like. With the modern antibiotic armamentarium at hand patients rarely progress to the stage of sepsis where this complication arises. It is interesting that in reviewing the literature for the past five years I was unable to find a single article in English devoted to the subject, and for this reason as well as because of my own lack of first hand experience in treating patients with purulent pericarditis, I should like to limit my remarks to a few general suggestions.

The therapeutic problem appears to be analogous to that in empyema with the additional hazards of cardiac tamponade and the later development of constrictive pericarditis. The first point of similarity is that the diagnosis can only be made with a needle. Secondly, as in empyema, systemic antibiotics alone cannot be counted on to handle purulent pericarditis. Local instillation of appropriate antibiotics is indicated since diffusion of adequate concentrations from the blood stream into serous cavities is problematical. Actually there are no adequate data that I know of on the levels of antibotics in pericardial fluid after parenteral administration.

Should signs of uncontrolled infection or persistent cardiac compression continue in spite of repeated paracenteses, the presence of loculation with the formation of adhesions between the parietal and visceral layers of the pericardium must be suspected and appropriate measures in-

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The antibiotics used were generously supplied by Chas. Pfizer and Co., and penicillinase by Schenley Laboratories, Inc.

stituted. The choice lies between surgical drainage and "medical debridement" with enzymes. Although I would hesitate to recommend it as an established procedure, the use of streptokinase and streptodornase would seem logical as a less drastic measure to be tried before resorting to surgery. These enzymes were instilled in the pericardium of one patient in Barnes Hospital this year without serious untoward effects.

The remaining time will be devoted to a discussion of some aspects of the treatment of bacterial endocarditits, which is still by far the most important bacterial infection involving the cardiac structures both in terms of frequency of occurrence and gravity of prognosis. During the past decade, it is true, the outlook in this disease has been transformed from one of utter hopelessness to one in which cure is to be expected as the general rule. Recently there has been a tendency on the part of some physicians to consider the subject a closed book, and to think that all one has to do in treating the infection is give several million units of penicillin a day for a few weeks. While such an attitude is understandable, it is also somewhat dangerous when one remembers that the mortality in bacterial endocarditis still averages around 30 per cent and has not been reduced appreciably in the past five years in spite of the appearance of several new antibiotics on the market during that time. Furthermore I cannot help being somewhat alarmed by the fact that three of the last four patients I have seen with the disease have had infections caused by an enterococcus. During the past year and a half only five patients harboring penicillin-sensitive streptococci have come under my care. I am sure that my experience does not reflect the true incidence of penicillin-resistant infections, but there is other evidence that resistant non-hemolytic streptococci are probably on the increase and account for somewhere around 20 per cent of cases[1] now rather than the 4 or 5 per cent encountered six years ago. The situation with staphylococcal infections is even worse in that two thirds of the strains isolated from a recently published series of cases[1] were found to be resistant to penicillin.

These facts make it clear that now more than ever before rule-of-thumb therapy with penicillin alone is hazardous and that every reasonable effort should be made to establish an etiologic diagnosis together with a careful evaluation of the infecting organism as to its resistance or sensitivity to the available antibiotics.

This leads us to the next real reason for discussing bacterial endocarditis at this time. How is one to decide which antimicrobial agent, or

what combination of them to use in a given situation?

With this problem in mind I should like to turn to a consideration of some of the fundamental mechanisms which seem to be involved in the cure of this disease, and to review some experimental work designed to have bearing on the therapy of this infection.

Bacterial endocarditis presents, I think, a rather special therapeutic problem which sets it apart from many of the other bacterial infections of man, in that it seems to be necessary with chemotherapeutic agents to eradicate the last viable organisms from the vegetations without expecting much help from the natural and acquired defense mechanisms of the host. Of course the latter are important in the recovery of the patient and in holding the infection in check, but by themselves they almost never succeed in completely eliminating the bacteria.

Furthermore I think it is safe to say that clinical experience to date suggests strongly that administration of a bacteriostatic drug even for many weeks is usually not successful. Specifically the sulfonamides, aureomycin, chloramphenicol and terramycin are all primarily bacteriostatic for the non-hemolytic streptococci and all have been disappointing in the treatment of bacterial endocarditis,[2-10] although the data on the last two are still scanty.

In contrast to the usual sensitivity tests which measure only the concentration of antibiotics necessary to produce inhibition of the growth of a small inoculum of organisms, generally under optimal conditions for the action of antibiotics, the studies reported here are designed to test antibiotics under conditions less favorable to their action.

The typical in vitro responses of the enterococci to various antibiotics are seen in Figures 1-5. In these figures, as in subsequent ones to be shown, are plotted the results of some experiments which were carried out as follows: A large inoculum of an overnight culture of the organism to be studied was added to a series of flasks containing 50 ml of nutrient broth so that a final concentration of between 10 and 100 million viable organisms per ml was obtained. Antibiotics were added at the time of inoculation to all flasks except the control to give the concentrations noted on the charts. At various intervals thereafter counts of the numbers of viable organisms remaining were made by means of poured agar plates which were counted finally after 72 hours incubation. Penicillinase was added whenever 0.01 u/ml or more of penicillin was present. Counts marked zero were usually checked by subculturing in broth and streak-

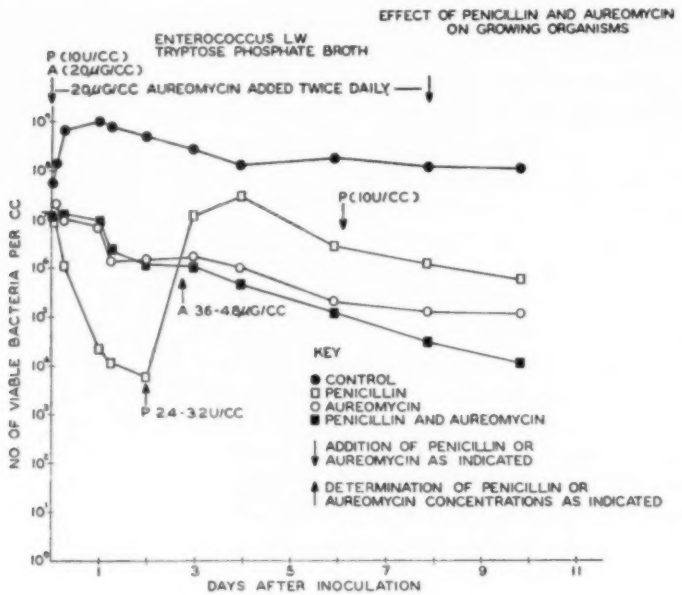


Fig. 1

ing on blood agar plates. Antibiotics were added to the flasks except in the experiments shown in Figures 1 and 2 at intervals as follows: Penicillin 20 per cent of the original concentration per day, aureomycin 100 per cent twice a day, and terramycin 30 per cent per day, so as to restore the antibiotic levels approximately to their original values at intervals.

These quantitative studies of the effects of some antibiotics on enterococci are particularly interesting when correlated with clinical experience and with the results of the usual sensitivity tests, which measure only the bacteriostatic effect of drugs. If one were guided by inhibition tests the drug chosen would usually be aureomycin, terramycin, or chloramphenicol, for as little as one microgram per cc. of one or another of them inhibits the growth of most enterococci. Yet when we follow what happens to a bacterial population exposed to 10 or 20 times the inhibiting concentration of one of these agents (Figures 1, 3, 5) we see that many viable organisms persist for weeks. If a similar effect exists in

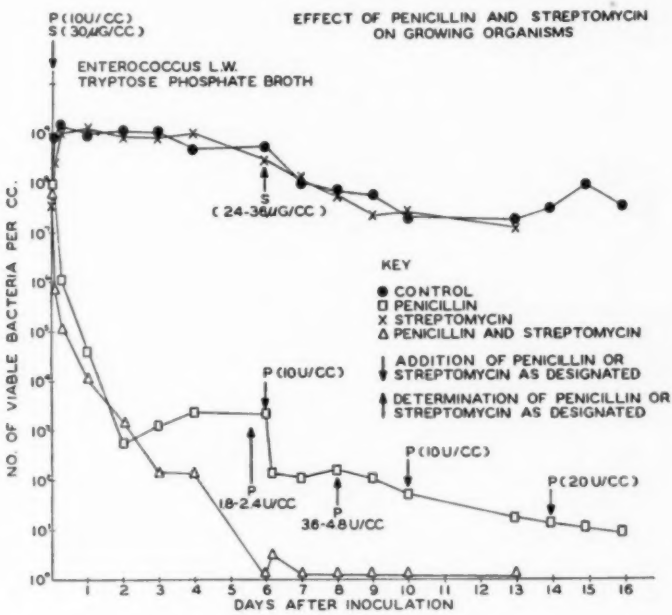
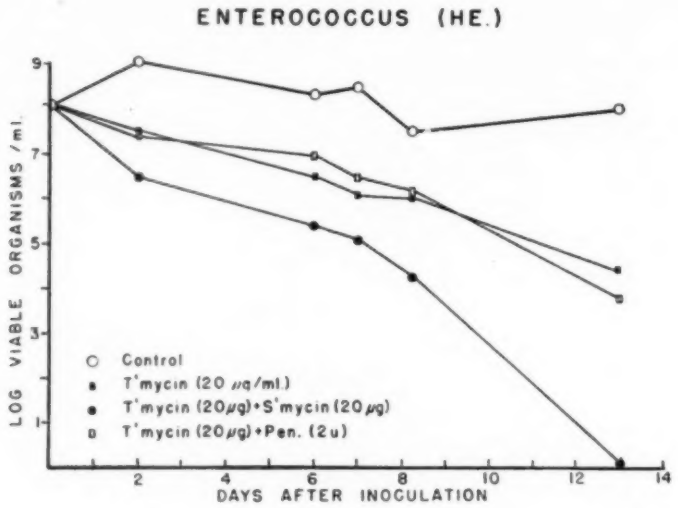


Fig. 2

the vegetation it is then not surprising that a good many patients relapse after treatment with these static drugs.

Penicillin (Figures 1 and 2) in this case does somewhat better at first, but at a concentration of 10 units per cc., which would correspond roughly with the average blood level attained by giving 10 million units a day, one still does not kill all of the bacteria. This finding in turn fits with the clinical experience that massive doses of penicillin alone frequently fail to cure enterococcal endocarditis.[3]

The effect of streptomycin is interesting and mysterious. By itself (Figure 2) no effect whatever on the growth curve of this organism is demonstrated, yet when streptomycin is added to penicillin (Figures 2 and 5) a rapid and complete killing of the whole bacterial population results. Again the clinical results with this combinaion of drugs fit with the in vitro findings. Several reports from this country and from Eng-


ENTEROCOCCUS (HE.)
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DAYS AFTER INOCULATION
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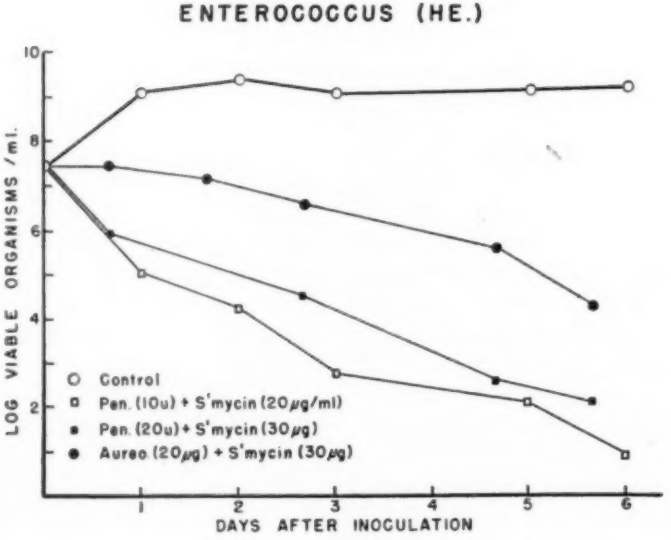
T'mycin (20 μg/ml.)
T'mycin (20μg)+S'mycin (20μg)
T'mycin (20μg)+Pen. (2u)

Fig. 3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DAYS AFTER INOCULATION
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Pen. (10u) + S'mycin (20μg/ml)
Pen. (20u)+ S'mycin (30μg)
Aureo (20μg) + S'mycin (30μg)

Fig. 4

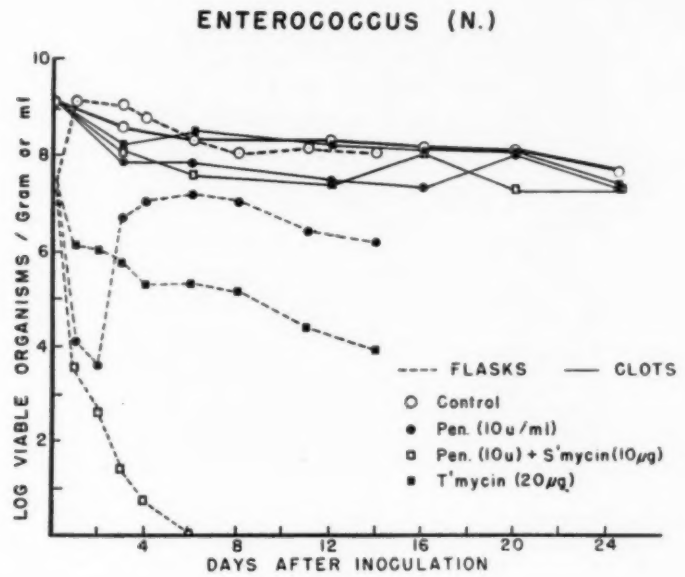

Fig. 5

land,[4-6] are in agreement as to the effectiveness of penicillin and streptomycin in the great majority of cases of enterococcal endocarditis.

The effect of combining penicillin with one of the bacteriostatic agents, aureomycin, chloramphenicol or terramycin, is difficult to evaluate at present because clinical data are largely lacking. In vitro it has been shown[7-10] that these agents all seem to interfere with the early bactericidal effect of penicillin, (Figures 1 and 3), but in some instances the bacterial population may eventually be markedly reduced. Success with this type of combination has been reported,[11] but for the time being at least it seems advisable to use penicillin and streptomycin as the first choice.

From observations on the in vitro effects of adding streptomycin to aureomycin or terramycin (Figures 3 and 4) one would be encouraged to try these combinations clinically. Personally I have not done so, in part because Dr. Geracci at the Mayo Clinic informs me that he has had a number of clinical failures using terramycin and streptomycin. Cates[6]

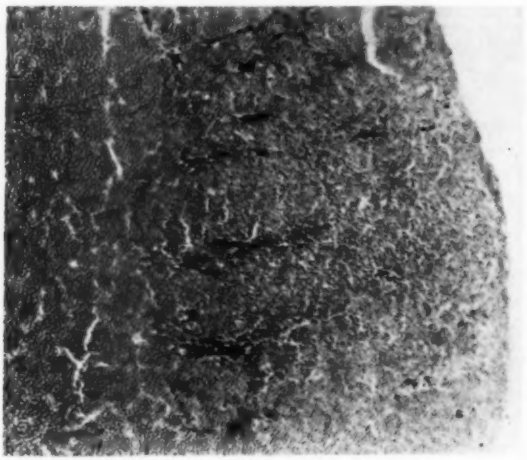

Fig. 6

also reports success with penicillin and streptomycin after failure with aureomycin and streptomycin.

It is notoriously dangerous to attempt to predict the clinical effectiveness of an agent from in vitro observations alone, but so far as we have gone the correlation of in vitro bactericidal action with results in patients is fairly good. Discrepancies exist, however, and in an attempt to elucidate other mechanisms which might have bearing on the problem, we have made some in vitro studies of the effects of antibiotics on infected blood clots.

The method is briefly as follows: 1 cc. of an overnight culture of the organism is added to a series of 25 silicone coated sterile Wassermann tubes to each of which is then added 2 cc. of freshly drawn human blood. The tubes are then mixed and allowed to clot. When the clots have retracted they are removed aseptically and transferred to tubes of nutrient broth. Thus a series of infected clots approximating the size of a large vegetation and weighing about 1 gram is obtained. These are then incubated and antibiotics are added to the surrounding media at intervals as in the previous experiments. The clots maintain their integrity for periods of weeks under these conditions, and individual clots from a

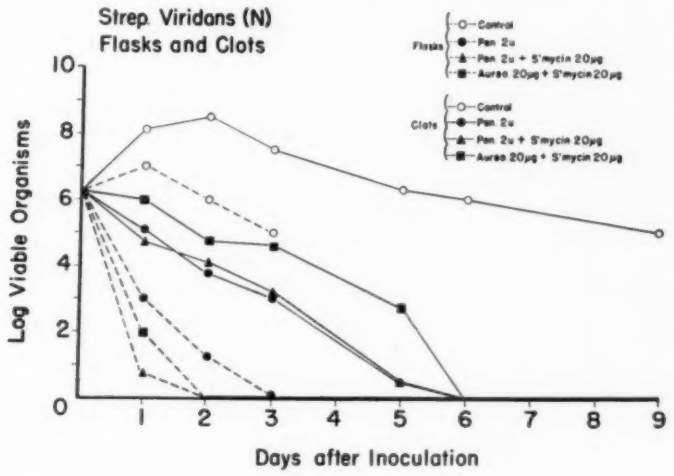

Fig. 7

series all exposed in the same fashion can be removed at intervals, weighed and ground aseptically. The numbers of viable organisms per gram can then be determined and a growth or killing curve constructed which provides a measure of the ability of antibiotics to eliminate organisms from a nidus of fibrin and blood cells. Figure 6 shows a low power photomicrograph of such a clot stained by the Gram-Weigert technique. The clot had been incubated for seven days and aureomycin 20 micrograms per ml had been added twice daily to the surrounding medium. One can see masses of bacteria in the depths as well as a few in the surface layer of fibrin in spite of the fact that the organism is sensitive by inhibition test to about 1.5 micrograms per ml of the drug. The viable count on this particular clot was 7 million organisms per gram.

Figure 5 shows the marked protective effect of the clot which we have found for an enterococcus. One sees that although the organisms can be eliminated from liquid media in six days by penicillin and streptomycin, large numbers of viable organisms remain for as long as four weeks in the clots. The patient from whom this organism was recovered was cured by a six weeks course of penicillin and streptomycin, however, which suggests that enterococci can be more readily eliminated

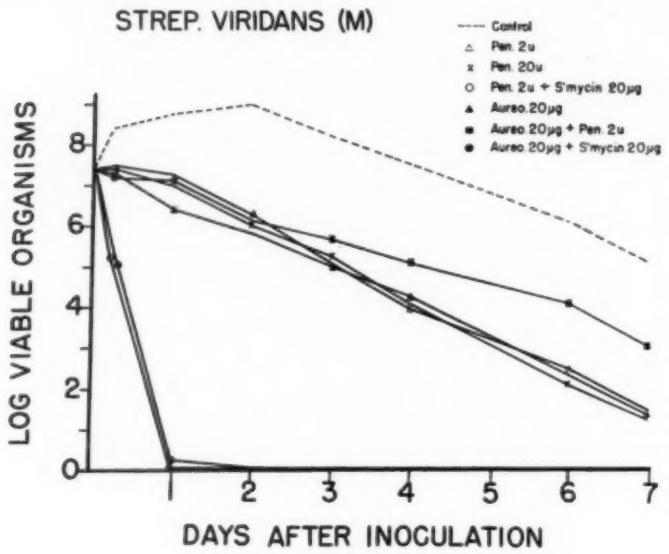

Fig. 8

from patients' vegetations than from clots in vitro at least under the conditions of this experiment.

So far we have considered only the enterococci and I think it is justifiable to stress infections caused by these organisms because of their refractoriness to the usual forms of therapy. Before leaving this subject it should be mentioned that occasional successes have been reported using truly heroic doses of penicillin alone (as high as 120 million units a day[12]) or in a few instances the combination of penicillin with bacitracin.[13]

Next I should like to present some data on ordinary penicillin-sensitive streptococci of the viridans variety with the following problems specifically in mind. What accounts for the occasional failure of penicillin therapy in a patient harboring a "sensitive" organism? Does the addition of streptomycin to penicillin offer any promise in treating this type of infection? What type of action do the antibiotics singly and in various combinations have on Streptococcus viridans?

In Figure 7 we see the response of a typical penicillin-sensitive strain. It is killed in a few days by penicillin alone when grown in liquid media

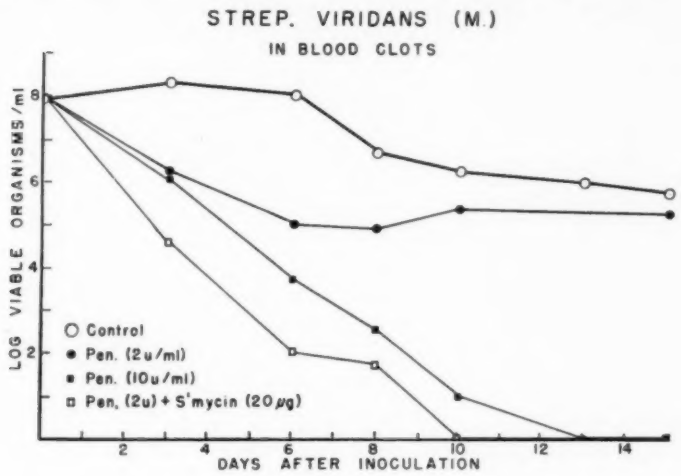

Fig. 9

and survives only for about 1 week in clots. The addition of streptomycin does not speed up the death of the organisms appreciably. On the other hand Figure 8 demonstrates that penicillin is not rapidly lethal for all strains even at a concentration of 20 u/ml. By inhibition tests this organism is as sensitive to penicillin as the first but it is killed much more slowly. Furthermore the addition of streptomycin in this case greatly enhances the bactericidal activity of penicillin in a fashion similar to that observed for the enterococci. Data on blood clots using these two organisms (Figures 7 and 9) demonstrate several points. In the first place penicillin, and penicillin with streptomycin are actively bactericidal in clots, but the latter afford some protection to the organisms and extend the time necessary for total killing of the bacteria two or more fold. Secondly, the strain variation noted in liquid media is still apparent but not so striking in the clot experiments. Nevertheless in every case penicillin and streptomycin together are at least as effective as penicillin alone and often more rapidly and completely so (Figure 10). Thirdly, in Figure 9 it can be seen that a high concentration of penicillin is definitely more effective than a moderate one in sterilizing the clot, whereas in liquid media (Figure 8) the same organism is killed just as quickly by 2 units as by 20 units of penicillin. Incidentally these strains of Streptococ-

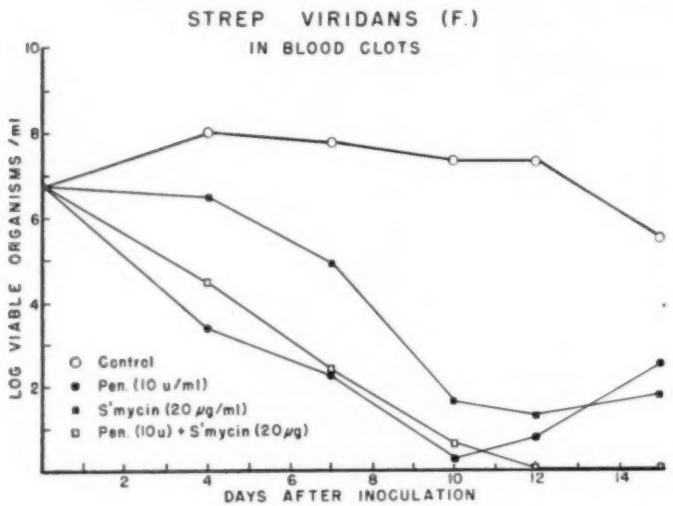
STREP VIRIDANS (F.)
IN BLOOD CLOTS
LOG VIABLE ORGANISMS /ml
10
8
6
4
2
Control
Pen. (10 u/ml)
S'mycin (20 µg/ml)
Pen. (10u) + S'mycin (20µg)
2
4
6
8
10
12
14
DAYS AFTER INOCULATION

Fig. 10

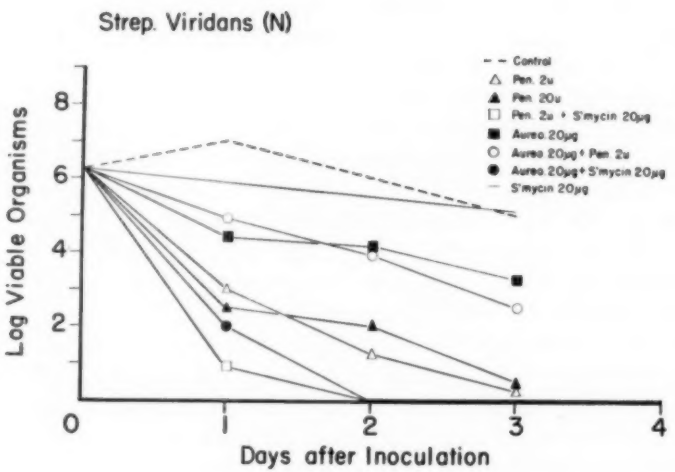
Strep. Viridans (N)
Log Viable Organisms
8
6
4
2
0
1
2
3
4
Days after Inoculation
Control
Pen. 2u
Pen. 20u
Pen. 2u + S'mycin 20µg
Aureo 20µg
Aureo 20µg + Pen. 2u
Aureo 20µg + S'mycin 20µg
S'mycin 20µg

Fig. 11

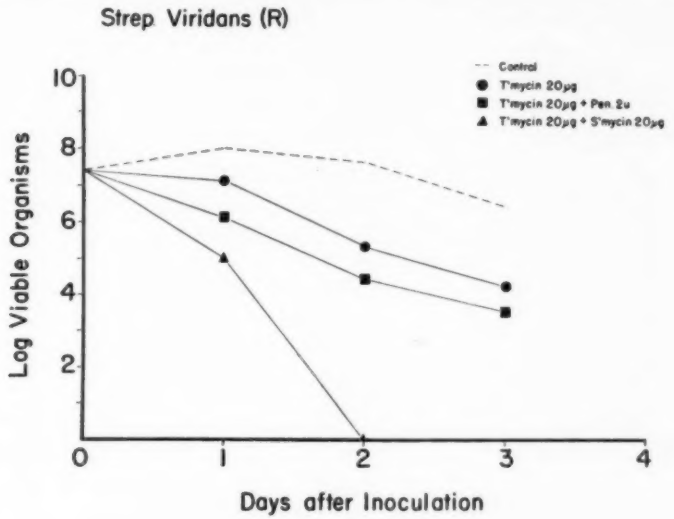

Fig. 12

cus viridans were recovered from a group of 5 patients, all of whom have been cured by a course of 2.5 million units of penicillin together with 2.0 grams of streptomycin daily for ten days. These organisms are all inhibited in vitro by 0.1 unit of penicillin or less.

The in vitro effects of aureomycin and terramycin on penicillin-sensitive strains are shown in Figures 11, 12, 13. In liquid media a bactericidal action is sometimes apparent (Figure 13) but bacteriostasis is the rule. The addition of streptomycin under these conditions usually results in rapid killing, again in spite of the fact that streptomycin by itself is usually ineffective. However, when the combinations of terramycin or aureomycin with streptomycin are tried on infected clots, the results are disappointing. Although aureomycin and streptomycin occasionally sterilize (Figure 7), the effects are usually those shown in Figure 14 where a marked protection of the organisms is apparent. Clinical data concerning the effectiveness of these combinations in patients are so scanty as to be of no great help at present, although a few failures with terramycin and streptomycin have already been alluded to.

The mechanisms whereby organisms are protected in clots against various antibiotics in varying degrees have not yet been elucidated, but

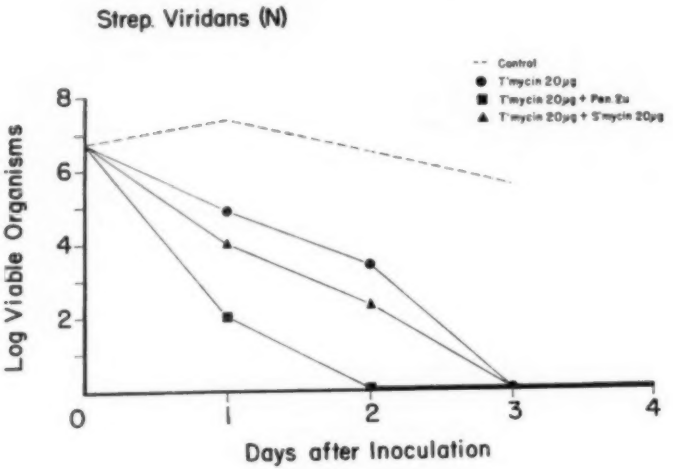
Strep. Viridans (N)
Control
T'mycin 20µg
T'mycin 20µg + Pen 2u
T'mycin 20µg + S'mycin 20µg
Log Viable Organisms
8
6
4
2
0
1
2
3
4
Days after Inoculation

Fig. 13

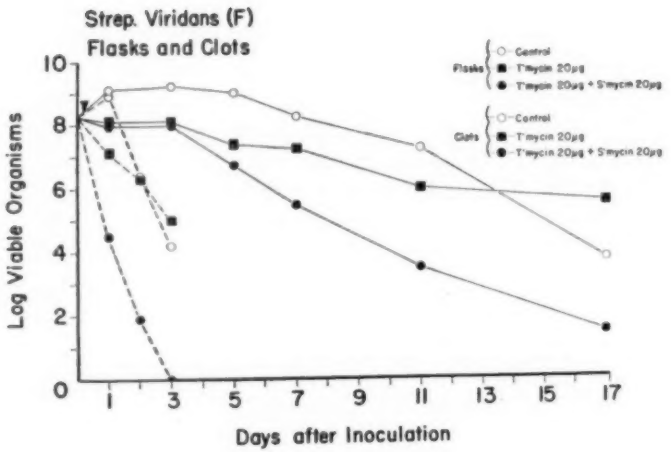
Strep. Viridans (F)
Flasks and Clots
Flasks
Control
T'mycin 20µg
T'mycin 20µg + S'mycin 20µg
Clots
Control
T'mycin 20µg
T'mycin 20µg + S'mycin 20µg
Log Viable Organisms
10
8
6
4
2
0
1
3
5
7
9
11
13
15
17
Days after Inoculation

Fig. 14

several possibilities come to mind. Variable diffusion into fibrin or chemical interactions with fibrin may play a role. A number of organisms are seen to be located intracellularly both in human vegetations and in infected clots, and it is possible that these intracellular bacteria may be protected against some antibiotics and not others. Lastly it is known that the metabolic and reproductive activity of bacteria influences very strikingly their susceptibility to antibacterial agents, rapidly multiplying organisms being, in general, more susceptible and resting organisms resistant. This is notoriously true of penicillin and in our hands is also true of other antibiotics. We have been unable to demonstrate total killing of resting populations of non-hemolytic streptococci by any antibiotic or combination of them which we have tried. It is not unreasonable to suppose that in some areas of a vegetation or clot, organisms may be in a state of maximum population density and hence in a temporary refractory state.

The practical implications of these observations and speculations are difficult to summarize. Perhaps the most important point to emphasize is that as new antibiotics come along, and many more undoubtedly will, their proper role in the treatment of bacterial endocarditis cannot be predicted by simply considering their inhibitory activity for non-hemolytic streptococci. The final court of appeal is of course clinical trial, but already the numbers of antibiotics and combinations thereof are so large as to force us to be selective in deciding what to try in patients. The studies reported herein are designed to give some leads as to possible means of selecting antibiotics which have a reasonable chance of proving effective in this infection.

Present evidence strongly favors the use of penicillin and streptomycin combined in enterococcal endocarditis. Optimal dosage and duration of treatment are not clearly defined, however; 10 million units of penicillin together with 2 grams of streptomycin daily for six weeks is probably the best current estimate. Although this regimen carries a high risk of damage to the vestibular apparatus, we feel that in such a serious infection taking this risk is justifiable.

In endocarditis caused by penicillin-sensitive organisms the evidence is not so clear-cut, but if it turns out that cure can be effected regularly in from ten days to two weeks using combined penicillin and streptomycin, the risk of encountering streptomycin toxicity will be small and the advantages over long courses of penicillin considerable.

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CLINICAL RESEARCH MEETINGS

THE NEW YORK ACADEMY OF MEDICINE
2 East 103 Street, New York City

April 23 and 24, 1952

The New York Academy of Medicine will hold meetings, Wednesday and Thursday evenings, April 23 and 24, at which investigators of New York City and vicinity will present results of original research in clinical medicine.

Presentations will be limited to twelve minutes. A brief period of free discussion will follow each presentation.

All persons interested in medical research are cordially invited to attend these meetings.

OBSERVATIONS ON THE REHABILITATION OF THE NEUROLOGICALLY HANDICAPPED*

EDWARD B. SCHLESINGER

Attending Neurosurgeon, Neurological Institute, Presbyterian Hospital;
Attending Neurosurgeon, Institute for Crippled and Disabled

AMERICAN Medicine after World War II resumed its normal aspect with few radical changes in method or orientation. Physical medicine is almost unique in its rate of growth, development, and impingement upon the public consciousness since the war. To neurologists (and here I hope you have the charity to include neurosurgeons) this phenomenon is of acute interest. Neurology has always been concerned with chronic disability. Its centers attest to the recognition of ancillary services such as physical and occupational therapy, along with social service of a high order. This paper, then, is in the nature of a neurologist's report on the naissant offspring of physical medicine – the so-called third stage – "Rehabilitation."

About six years ago I took part in a symposium on the care of "paraplegics." The Armed Forces were deeply concerned with large numbers of these chronically handicapped patients and such meetings were designed to explore their special problems and bring out improved techniques in their management. There was a strong feeling of pioneering amongst us and the Armed Services brought to the task a strong emotional charge, which I may say parenthetically the field has never lost. When I returned to civilian life I was surprised to find that the most efficient techniques we had seemingly developed were being routinely used in established centers, and had been for a long time. The sole disparity I could detect lay in the differing emphasis upon the spiritual or emotional as opposed to the physical aspects of treatment. In my own mind I concluded that the new and highly advertised war-born science of rehabilitation was nothing more than good old-fashioned physical medicine with a strong dose of Christian Science thrown in.

* Presented before the Section on Neurology and Psychiatry, The New York Academy of Medicine, December 11, 1951.
From the Department of Neurosurgery, College of Physicians and Surgeons, Columbia University; The Columbia-Presbyterian Medical Center, Neurological Institute; and the Institute for the Crippled and Disabled, New York.

With the backwash of severely handicapped from World War II there was bound to be a vigorous recrudescence of general interest in the lot of the chronically disabled. One can only applaud the sense of responsibility which led to the broadening of training opportunities for workers in the field, and to the increasing number of institutions available to the patient. Such growth must be fertilized by intense energies and the initial period of such growth is more often characterized by enthusiasm than by pessimism or a strong sense of limitation of opportunity. These can only come from experience and re-evaluation over the years.

I have taken a good deal of time trying to emphasize the fact that the post-war course of rehabilitation has been characterized more by religious fervor than by tongue-in-cheek sober practicality. The analogy to religion is not lacking in aptness – both have their goal in the unforeseeable future and the attainment of the goal often depends upon unworldly or superhuman zeal. There is wisdom in informing the public of improved outlook for the chronic disabled and gaining their enthusiastic cooperation. Too often, however, an unclear picture of the ultimate and strict limitations of the handicapped is presented.

On too many occasions the public has been led to believe that there is no limit to the possibilities of improvement. The centers are besieged by post-vascular accident hemiplegics and similar cases, each filled with the perseverant concept that normalcy is just around the corner. I have searched time and time again for evidence of the new miracles to be offered such patients and come up with the traditionally limited available therapy. The danger here is the disillusionment inherent in the patient being led to expect too much. It is time to subordinate spiritual goals and enthusiasm to more specific medical goals.

What is much more important (and the real subject of my report) is the impact of the physical rehabilitation program (as opposed to spiritual or emotional) on the crippled patient. In the last few years I have, as a consultant neurological surgeon, seen and examined an impressive group of patients, all undergoing intensive rehabilitation and all excellent examples of what I choose to call stress breakdown. Now, every bridge or truck axle has a definite and recognized maximum load. It is a striking fact that similar recognition is seldom given to the human load factor. We glibly talk of ambulation possibilities in the "low dorsal" case, the "mid dorsal" case, etc. How often do we think of the

tremendous and unphysiological stress inherent in the gait techniques we teach these patients? Among these cases the following may illustrate my point: median and ulnar, or, more usually, median nerve injuries developing in the course of mobilization of a cane walking hemiplegic, two paraplegics, a spina bifida with paretic lower extremities, and a cerebral palsy patient with athetoid quadraparesis. Another paraplegic patient with a mid thoracic level developed the classical syndrome of axillary thrombosis, another a scalenus anticus syndrome. Two Parkinson patients and a mid-thigh amputee appeared with evidence of lumbar disc protrusion. An old poliomyelitis victim, made to stir from his fireside and wheelchair by news of rehabilitation, died of a coronary occlusion – aged 30! These patients are all examples of unrealistic application of stress without adequate knowledge of their maximum obtainable efficiency under pathological conditions.

Some of the lesions described are easily understood and their etiology traced with equal ease. Others are not so easily traced to their source. The shoulder girdle and upper extremities are designed chiefly to convey a remarkable range of motion and leverage efficiency to the human frame. The bony frame and muscular sheath have evolved in such a manner as to allow pressure free continuity of vascular and neural channels. In the normal 20th century individual a large number of syndromes are becoming recognized clinically, all basically due to compression of vascular or neural elements. How much of this dynamic pathology is due to heavy exertion in the face of a poorly conditioned muscular coat we can only surmise. In the paraplegic patient, however, the use of the shoulder girdle and arms as a weight bearing mechanism throws a new burden on structure. The typical crutch paralysis, due to faulty management of the crutch with axillary pressure we can discount as obvious. Under proper conditions, it is still necessary to stabilize or fixate the shoulder girdle muscles for weight bearing *and* range of motion, and likewise fixate the wrists, again with some but less range of motion. The addition of heavy weight bearing and splinting of the shoulder girdle and wrist to normal function imposes unusual conditions on the thoracic outlet, the neurovascular bundle, and the more vulnerable tendinous insertions and peripheral nerves. The median pareses, which are quite common, are complex in origin, based in part on structural diathesis, the aforementioned stress, undue stretch in the position of use, tendinous compression, and direct pressure. These lesions are

seen frequently in occupations where there is a good deal of wrist motion, such as the concert pianist. At times the median injury is overshadowed by the tenosynovitis of the flexor carpi radialis, the so-called de Quervain's disease. At times, exploration reveals the swollen bursae or tendon sheath has been the cause of the median compression, rather than direct trauma to the nerve from stretching. Occasionally exploration of the involved nerve yields no information and yet decompression is followed by relief of symptoms. In the weight-bearing upper extremity of the paraplegic the problem is seriously compounded and the suspected vulnerability of paraplegics to such lesions is borne out in fact. It is important to instruct the therapists to watch for the appearance of suggestive symptoms and signs. Pain at the wrist or in the hand, numbness and tingling, and silent atrophy should be noted carefully and traced to their source. Continuing rehabilitative therapy in these patients is a baffling problem and one is almost tempted to say they are better off in their wheelchairs, with a more limited goal of self care.

Which again brings me to my theme. Goading the body on by over-emphasizing the spiritual aspects of rehabilitation tactics and confusing these with purely physical considerations is at the base of many such examples of stress breakdown. There are many corollaries to this theme. One of my vivid impressions is of seeing instituted long and impressive schedules of rehabilitation for such patients as hemiplegics (of vascular origin), post-operative brain and spinal cord tumors, and so on. With life expectancy short would it not be better to lower the goal and give the patient some time to sit in the sun? I suspect such rehabilitation measures share the cowardice of us surgeons who at times send our patients for radiotherapy for lack of courage to say, "This is the end of the road"—"There is no other therapy." Post-vascular accident hemiplegics, particularly, for good reason, perseverate in the idea of return of function and will cooperate to an alarming degree in any scheme of physical exercise ad infinitum, with the blood pressure pounding away at fantastic levels and the cerebral plumbing yielding at the joints. After many types of lesions, for physical or psychological reasons, the patients are refractory to the idea of not regaining normal function and it is the obligation of the physician to literally pull them off the merry-go-round rather than make them spin more merrily. Such a chore is distasteful but terribly important.

In somewhat similar fashion, but for psychological reasons, patients

will replace normal goals with that of physical perfection to a point where it occupies their entire lives. Meanwhile time, which is finite, ticks on. I know one such patient, a retired officer, whose home is a veritable gymnasium, and who maintains a furious pace of exercise from dawn to dusk. He is a psychological derelict, not a physical one, since his natural talents, properly directed earlier, would have made him a thorough going success from a wheelchair.

Speaking of time, it is interesting to think of what a combination of physiological aging and pathological stress will bring about in these patients. For one example, the circulatory burden is enormous. In the erect posture the normal supporting and pumping action of the peripheral muscles plays a significant role in maintaining efficient venous return to the right side of the heart. The special effort of effecting locomotion without the use of lower limbs is reflected in increased cardiac work, with the added burden of a serious alteration in the dynamics of venous return. I suspect the coronary occlusion in the poliomyelitis patient mentioned earlier was the product of such a set of circumstances.

How many of the patients who have laboriously mastered the swing-through gait will be able to continue it into the fourth or fifth decades and at what price in the rate of structural breakdown? Along these lines I have been struck by the apparent inverse ratio between vocational success and the continuance of ambulation. Most successful paraplegics find they are more efficient in a wheelchair and have no time for strenuous exercise. The percentage of patients still using the painfully learned crutch gaits is disappointingly small. Preliminary studies of a large scale follow-up at the Institute for Crippled and Disabled tend to bear out this observation. I would abstract my own feeling by saying, "Teach them enough crutch technique for good self care, the importance of exercise to keep in condition and avoid complications, and then hurry them into vocational pursuits." If one says that is just what is done, the long files that accompany the patient from center to center belie the fact.

The position I have taken today, I must add, is based upon a sincere recognition of the importance of many of the entities I have decried – spiritual values, enthusiasm, the excitement of exploration and achievement of new goals. Likewise it does not imply anything but deep respect for the methods and achievements of sound physical medicine.

Actually rehabilitation is nothing more than sound follow-through medicine. Because it was largely honored in the breech in latter years, the present day emphasis on it is obviously of real value. What I have been attempting to do today has been to fit it into the warp and woof of traditional medical approach. When the unbraked illusions of the human spirit are allowed to set the goals for the disabled body, fascinating patterns of structural breakdown appear. Many of these we are just beginning to recognize, for the simple reason that we have only recently induced them. To come of age, the science of rehabilitation must include the responsibility of protecting structures on the physical side, and preventing misguided zeal and disillusion on the spiritual.

The Charles H. May Memorial Lecture

Orthoptic and Surgical Treatment of Non-Paralytic Strabismus

by

T. Keith Lyle, M.A., M.D., M.Chir., (Cantab); M.R.C.P. (London); F.R.C.S. (England)

Ophthalmic Surgeon, Kings College Hospital;
Civilian Consultant in Ophthalmology, R.A.F.

Under the Auspices of

The Section of Ophthalmology

Monday Evening, April 21, 1952, at 8:00 o'clock

Held at

The New York Academy of Medicine

2 East 103 Street

GROUP THERAPY WITH EPILEPTIC CHILDREN AND THEIR MOTHERS*

ZIRA DE FRIES AND SUE BROWDER

Department of Neurology, College of Physicians and Surgeons, Columbia University and the Neurological Institute, Presbyterian Hospital, New York

CHILDREN with epilepsy have, in addition to the usual childhood problems of adjustment, a great many anxieties and severe emotional disturbances which are related to the disorder and which stem from the nature of the illness and the prejudiced attitude of our culture toward it. The parents of epileptic children, likewise, have many anxieties about the medical and psychological effects of the illness upon their children. Treatment of epilepsy, therefore, should concern itself not only with an attempt to decrease or control the incidence of seizures, but should also be directed toward a solution of the associated emotional problems, which, in many instances, are as disabling as the disease itself.

The treatment of epilepsy in our clinic has been approached from a combined medical-psychiatric point of view which aims at attaining control of seizures by the usual anti-convulsive medication and also at improving the emotional adjustment of both parent and child by means of individual and group psychotherapy. The study we wish to present this evening is a progress report of our experience with the use of group psychotherapy with epileptic children and their mothers. Group therapy appeared to be a logical form of psychotherapy with these subjects because the factor of the illness provided a common meeting ground. It was felt that direct discussion of seizures in a group would bring to the fore the emotional conflicts engendered by the disease and would thus help to relieve the associated anxiety and make for more rapid improvement in adjustment in the parent-child relationship than would be possible with individual therapy.

This study, which began about one year ago, consisted of four groups – one group of boys, another group of girls and two groups composed of the mothers of these children. There were seven children

* Presented at a Joint Meeting of the Section of Neurology and Psychiatry and the New York Neurological Society at The New York Academy of Medicine, January 8, 1952.

in the boys' group, ranging in age from 10 to 13 years, and six in the girls' group from 8 to 11 years. All the children but one had major seizures, one had petit mal attacks only, and all but one were receiving standard anti-convulsive medication which was not changed appreciably during the course of the study. All the children had abnormal EEG patterns. Intelligence tests showed an average I.Q. of 88 for the group of boys and 101 for the girls. The children in both groups had in addition to the common anxieties over epilepsy, varying degrees of behavior disturbance. The groups of mothers presented a diversity of problems which ranged from mild anxiety over the child's seizures to deep seated personality problems. Projective tests, including Rorschach, Thematic Apperception and others, were administered to the children and mothers before and during the course of the study; the results of these tests in general confirmed the presence of personality disturbance.

The groups of mothers and children met simultaneously in adjacent rooms for a period of one hour at weekly intervals. The boys' group was an activity group in which play was the medium of expression with relatively little verbalization taking place; the girls' group was considerably more articulate and did not always need play to sustain the session. The children's therapist offered no direction to the type of play during the sessions, but did interpret behavior patterns when it was felt that verbalization of these would relieve anxiety in the child and stimulate group discussion. The subject of epilepsy was introduced by the therapist in the early sessions and later came up spontaneously. In the mothers' groups, the attitude of the therapist was a permissive one and there were no set topics for discussion. When questions about epilepsy were asked, these were answered directly and in a simple manner. In every instance, however, in which the therapist was asked for a direct expression of opinion on a subject not related to epilepsy, the mother was referred to the group for discussion. The mothers participated freely in discussion from the beginning, and after a few sessions they did not hesitate to attack one another's opinions. The therapist's interference in these verbal attacks was seldom necessary, for a mother was rarely left without an ally in the group. When new members entered the group, the older members were asked to brief them on the purposes of the group as the therapist had done originally.

During the course of therapy, a number of interesting changes in attitudes and behavior patterns emerged. In the boys' group, there was

a significant change in the attitude toward seizures. The early attempts of the therapist to initiate discussion of seizures had the effect of startling most of the members, who expressed perplexity and resentment that this should be discussed openly and freely. It did not take long, however, for each member to develop an awareness of the others' seizures and of the common problem they shared. Resentment and shame soon gave way to curiosity about the others' attacks and in subsequent sessions a frank and open interchange of description of seizures and feelings about them evolved. This further developed into a feeling of "pride" about attacks and each boy vied for the opportunity to describe his own. At times they were able to laugh about their seizures and one boy jokingly referred to his attacks as "pepsilepsy." This acceptance of their own and the others' attacks was felt to be an important aspect in the development of group unity and in enabling the boys to look upon their illness with less of the aura of shame and secrecy with which they previously regarded it.

In addition to this altered attitude toward their seizures the individual behavior of the boys in the group improved considerably. Thus the boys were originally a disorganized and inarticulate group in which overt aggression was frequent and uncontrolled. They did not play with one another and engaged in no sustained group activity at the outset. As they acted out their particular problems and gained insight into their patterns of relating to one another, a new group seemed to emerge in which more organization and cohesion were apparent. Aggression was less diffuse and better controlled and each member developed an increased feeling of confidence and self-respect, which enabled him to relate in a less neurotic and more effective fashion to other members of the group. Behavior at home, as reported by the boys' mothers, likewise showed some degree of improvement. This was felt to be attributable to the combined factors of objective change in the child's behavior, as well as to the fact that the mothers, through their own group experience, had become less anxious and more accepting in their relationship with the children. School progress was difficult to evaluate, some of the boys' problems in school being related to prejudiced attitudes on the part of teachers and school authorities.

The girls were from the beginning a more articulate group; they could express feelings more directly and had less need to act out aggression, with the exception of one extremely hostile girl. School, sibling

rivalry, sex, and parental hostility were openly discussed. There was less dependence upon the therapist and less need for approval. Discussions of seizures were initiated spontaneously by the girls, one of them telling of her anxiety and re-enacting her fears for the other members. One girl had not known of her grand mal attacks, having been shielded from knowledge of them by her mother; when told what her "sickness" was, the news was accepted with relief. She now knew why she had been taking pills for the past several years. It is of interest that many of the girls attributed their seizures to preceding emotional upsets. None expressed a feeling of hopelessness about their attacks and all showed a great deal of interest and curiosity about those of the other girls. There were free discussions of adverse reactions on the part of teachers and neighbors, and expressions of some anger and disdain toward the ignorance and lack of understanding displayed by many adults. The behavior at home of two of the girls was reported by the mothers as improved and in two the fear of school was notably lessened and a concomitant improvement in school work occurred.

As regards alteration of seizure frequency, no conclusions can as yet be drawn because of the relatively short period of observation. In one girl, seizure frequency was significantly reduced; in one boy who had several convulsions nightly, these decreased to an occasional nightly seizure only; in some the frequency of seizures was unchanged and in others seizures were so infrequent as to invalidate comparison.

The groups of mothers initially spent their sessions asking questions about epilepsy and complaining about the behavior of their children. Gradually the discussions became freer and broader and were concerned with the more pertinent aspects of mother-child relationship and with personal problems, some mothers describing dreams and associating to them. As time wore on questions about epilepsy were raised only when new members entered the groups and these were answered by the older members correctly and authoritatively. The members soon used the word epilepsy spontaneously and without reserve and showed a greater feeling of ease and acceptance about the illness. Mothers who were previously over-protective of their children allowed them increased freedom and as a result of their changed attitude, sanctioned participation in activities which they had formerly prohibited. Thus, for example, one child was allowed to dive and swim alone for the first time and another child to travel downtown alone. With decreased fear and

anxiety over seizures, the mothers were able to re-examine their relationships to their children, which they could now see with fewer distortions. Many of the mothers related proudly that improvement had occurred in their children's behavior as a result of improvement in their own feelings.

The effect of group therapy can perhaps be best illustrated by presenting a typical case.

L. F., an 11-year-old boy, was admitted to the clinic with focal seizures which later became generalized. These occurred most frequently at night and on the average of 10-12 per day. There were no abnormal neurological findings. Pneumoencephalogram made during a hospital admission showed mild bilateral cerebral atrophy. The psychological picture was that of an extremely anxious and apprehensive child who was in constant dread of seizures, yet who at the same time, used the seizures to dominate his parents. He was abusive to his mother, using obscene language and frequently attacking her physically. He was extremely fearful of his father, related poorly to other children, and at the time of admission to the clinic had been withdrawn from school. On anti-convulsive medication and individual psychotherapy, he showed some improvement in adjustment and a decrease in number of attacks to approximately two per night. It was felt that this boy, an only child, was very much in need of relationships with other boys and that group experience would be an important aspect of therapy.

In the group he was initially shy, timid, withdrawn, and fearful. During the early sessions he appeared at times to be almost immobilized with fear; he stayed in safe range of the therapist and needed a great deal of protection from the rest of the group, who would either ignore or taunt him. He was repeatedly bullied and maltreated by the group. It was apparent to the therapist that underlying his fears there were extreme hostility and rage which had to be expressed before any change in behavior could be expected. He was gradually encouraged to express the anger he felt and the turning point in therapy occurred when, after a particularly unjustified attack by the bully in the group, he shouted his murderous desire and screamed wildly. Subsequently, further expressions of rage were elicited but with steadily diminishing intensity. The violent quality of the rage gradually gave place to appropriate anger, which was acceptable to the group, with the result that he began, for the first time, to participate in some of the

competitive and aggressive activities of the other boys. He still remains somewhat on the periphery, but is a more active participant and has much less fear and anxiety. He is no longer excessively dependent upon the therapist, although he is still greatly in need of acceptance and approval. This boy's experience with the stronger bullying boy in the group was in some respects a repetition of his relationship with his father and hence accounts for the dramatic and intense quality of his fear and rage. His seizures are infrequent at the present time; his fear of seizures has been markedly alleviated, and his behavior at home considerably improved. In addition, he has been able to return to school where he has made a satisfactory adjustment.

This boy's mother at first maintained an aloof and detached manner in the mothers' group. She was opinionated and dogmatic, and her statements about her son were primarily rejecting. Consciously she described an accepting attitude toward epilepsy and railed against society for its unenlightened attitude. She showed no insight into her rejection of her son and the fact that she used his epilepsy as a means of further rejecting him. During the course of therapy, however, she began to question her attitude toward her boy as well as some of her own deeper and more unconscious feelings about epilepsy. Although she is still rejecting, she is able to allow her son a greater degree of independence and is now a good deal less critical and less remote in her relationship with him.

In conclusion, we feel from our experience, that group psychotherapy with epileptic children and their mothers is an effective and useful part of the therapy of the child suffering from both seizures and personality disturbances, and is more effective in some instances than is individual psychotherapy. The common problem of seizures was used initially to bring the groups of children and mothers together, and subsequently the group moved forward to a more direct attack on the complicating emotional problems once the anxiety over seizures had been relieved.

THE MEDICAL MANAGEMENT OF ACUTE AND CHRONIC ARTERIAL OCCLUSION*

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With the evolutionary changes in medicine of the past two to three decades, the medical man of today is faced with arteriosclerosis as the leading pathology of our age. It is therefore natural that he will frequently be faced with the management of this disease as it affects the extremities. I use the term management in preference to treatment in that since the etiology of arteriosclerosis is still unsolved we therefore have no specific therapeutic approach.

The purpose of this presentation is to analyze the available methods of management now in vogue and to attempt to outline a procedure that is both rational and most apt to produce satisfactory results. Many therapies have been developed and tried and while it is true that some of these apparently produce results when used by those who developed them and are familiar with their minute details, these same therapies fail when used generally.

There are those who make exorbitant claims for specific modalities of treatment and on the other hand those that feel that little can be done when arteriosclerosis blocks peripheral blood vessels. There must be a happy medium and a method of management which will effect an increasing blood supply to an extremity with arteries partially obliterated.

Tonight you are also going to hear from a surgeon who will outline his approach to this problem. The fact that he is on this program should indicate that in this disease both medical and surgical methods of management should be considered. The patient will benefit when a well balanced team of a medical man and a surgeon cooperate—or when either a medical man or a surgeon has a well balanced insight into the specific case.

Analysis of the Problem

A set plan of management cannot be laid out which will fit each and every case of occlusive arterial disease. Every patient presents a different

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set of problems in his management and these must be studied from both the general standpoint and from a proper analysis of the actual vascular changes in the extremity. I do not believe that all cases of peripheral arteriosclerosis should undergo a sympathectomy, as recently stated at a meeting of specialists in this field; nor do I believe that the use of a certain vasodilating drug is the therapy of choice.

From the general standpoint one must first consider the temperament of the individual. Is he the type who will cooperate in a conservative regime—who will relax while under treatment and who will accommodate himself to his limitations? If he is this type his prognosis is immediately improved.

Secondly are there associated vascular involvements that will make his management difficult? Particularly is there cerebral involvement to hamper his cooperation or to make it difficult for him to understand his problem? While a physician should not be too pessimistic to the patient about the outcome of his specific case, it is well to present the various possibilities and to especially emphasize the time factor in the course of this disease—one frequently losing the confidence of his patient if he tells him that a lesion should heal in a few weeks and instead takes several months to achieve the result or fails to heal.

There may also be associated disease independent of the vascular pathology. The patient may have diabetes, increasing the gravity of the vascular changes. He may have osteoarthritis making a long period of bed rest impossible or adding confusing symptoms, frequently mistaken for those secondary to his vascular disease. There may be disease of the spinal cord, blood dyscrasias, vitamin deficiencies, orthopedic defects, or any one of many less common diseases. The failures in the management of a vascular problem often result from the lack of recognition and proper treatment of the associated disease.

The analysis of the actual vascular status in the involved extremity is of utmost importance in arriving at a regime of management. The following information is of greatest value. It can only be obtained by an understanding of the pathology, a history and a complete clinical and laboratory study.

Pathology

The vascular pathology in peripheral arteriosclerosis is most variable. You have listened to most excellent descriptions of these changes by

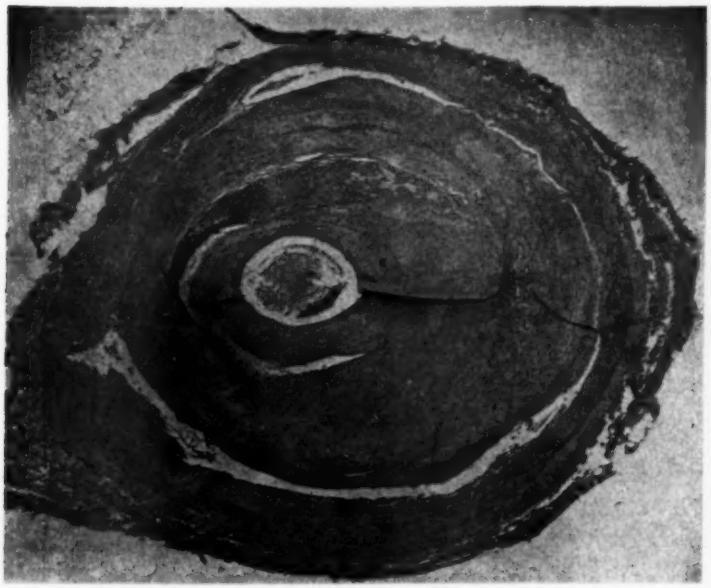

Fig. 1—Marked Atherosclerosis of the Popliteal Artery with narrowing of the lumen.

previous speakers on this Graduate Fortnight Program.[1, 2] Smaller end arteries may be the site of most of the pathological changes or these vessels may be little involved and the main "shut off" take place by a thrombosis in the major arterial supply in an extremity. I shall not attempt to cover in detail the many variations noted but I would like to impress the point that there is no usual or set pattern of involvement.

The actual process in the wall of the vessel may consist simply of soft or atheromatous changes or it may be associated with fibrosis and the deposition of calcium. Pathological changes of a degenerative and replacement nature may involve the media and leave the intima relatively normal. Reduction of blood supply in this type usually occurs as a result of the narrowing of the ostia of the branches of the arteries.

When intimal involvement takes place two chief changes are noted; first thickening and then thrombosis—many cases have a gradual narrow-

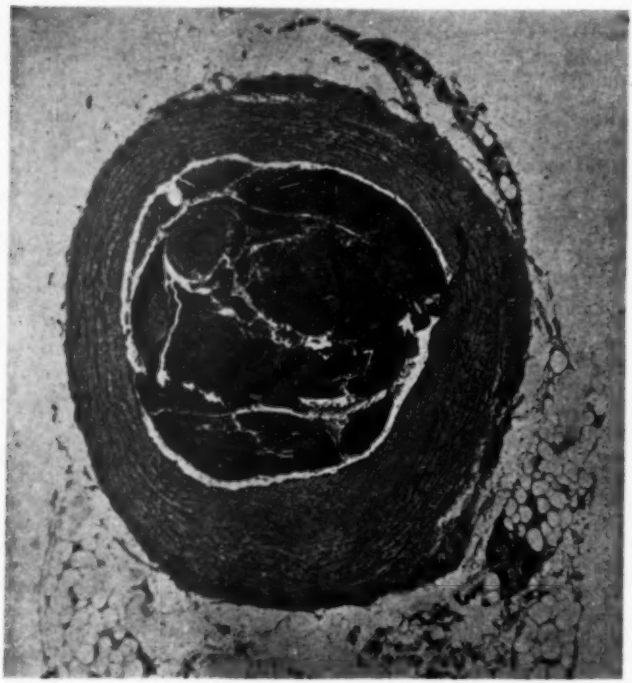

Fig. 2—Atherosclerosis of Posterior Tibial Artery with an acute thrombosis.

ing of the vessel lumen while others superimpose a sudden thrombosis—even early in the course of the disease (Figures 1 and 2).

Peripheral arteriosclerosis is usually segmental in nature, that is, local areas of a vessel may be involved with a relatively healthy wall remaining distal and proximal to the diseased area. For example, an arteriogram may show a site of occlusion in the femoral artery with collateral circulation filling a patient's femoral vessel below the occluded area (Figure 3). It is also episodic in its occurrence.

The degree of calcification as shown by x-ray, moreover, is not an indication of the degree of arterial impairment and the failure to visualize calcium does not rule out arteriosclerosis as being present (Figure 4).

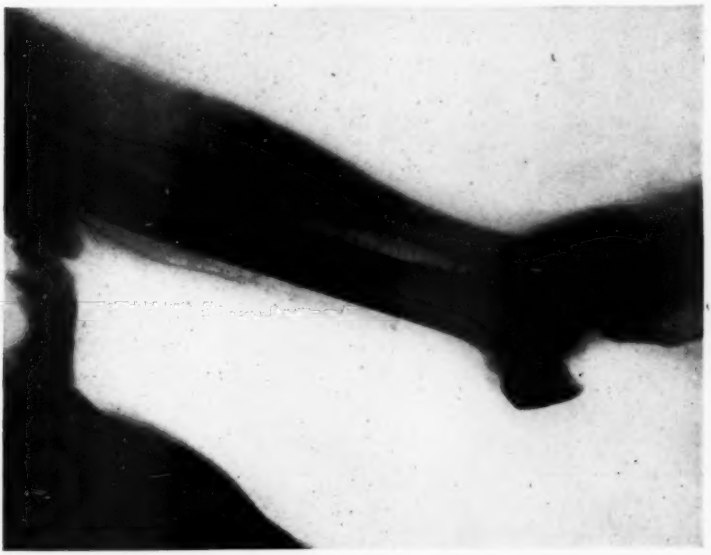

Fig. 3—Arteriogram showing a thrombosis of the mid portion of the Femoral Artery with excellent collateral circulation around the point of obstruction.

Recanalization of a thrombosed vessel may occur but such a healing process is rare and usually productive of little blood supply.

One must also consider functional pathological changes in every case of impaired arterial supply. In arteriosclerosis these changes are usually not marked in the early course of the disease, but when pain, especially rest pain, develops, then a reflex spastic state of the vessels with insufficient organic change to affect their ability to contract, may take place. This further reduces blood supply and its control is the basis for much of the therapy advocated in the management of this disease.

Although the associated venous drainage is not usually affected to the same degree by organic changes in the walls of the veins, secondary venous thrombosis is common and complicates the arterial pathology. Such thrombosis probably occurs as a result of a reduced rate of blood flow, a reduced activity of the patient and because many of these patients have associated varicose veins.

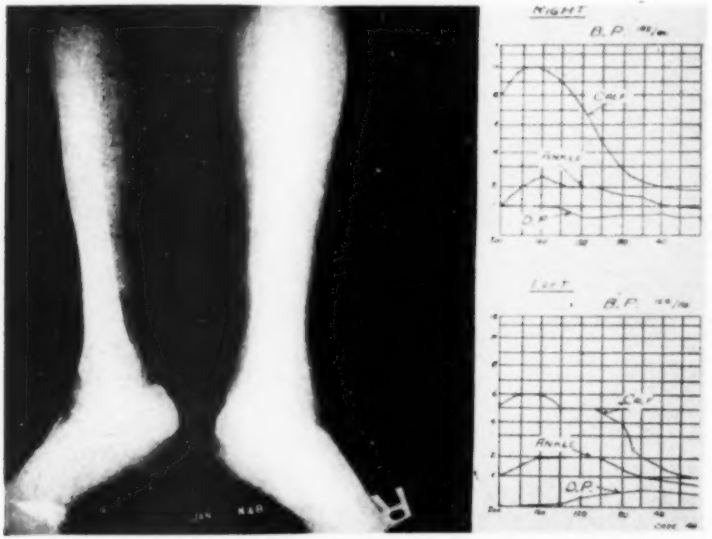

Fig. 4—Normal oscillometric readings on lower extremities showing a very marked degree of calcification.

History

1. *Distress:* The patient with arterial insufficiency usually first complains of symptoms suggestive of intermittent claudication.[3] This may come on gradually during a period of months or years or may be of acute onset. There is greater chance for the development of collateral circulation in the slowly developing occlusion than in the case with a sudden arterial shut-off.

This extremity distress must be differentiated from pain secondary to spinal arthritis or other associated disease. Such pain is frequently present most of the time – aggravated usually, at the start of activity and not relieved by the cessation of activity. Intermittent claudication moreover is not usually manifested by a true pain, but rather by a sense of tightening in the muscles and an inability to walk with almost immediate relief by the cessation of walking.

When arterial insufficiency has progressed to a point where pain is

present at rest, such pain is usually severe; more apt to occur after the patient has gone to sleep and relieved by placing the extremity in the dependent position.

2. *Temperature changes*, especially coldness, occur with both organic and functional arterial disease and more frequently are an indication of vasospasm than of organic occlusion. However, when one extremity is cooler than the other then organic occlusion is more likely responsible for the reduction in skin temperature.

3. *Slow nail growth* with transverse ridging of the nails indicates periods of reduced nail bed blood supply.

4. *Night cramps* are usually an indication of venous stasis and not of arterial insufficiency. They should be differentiated from night rest pain which is usually not associated with muscle cramps.

As one can see, there are not many symptoms related to peripheral arterial insufficiency and the disease may progress to a considerable degree before the patient is aware of his difficulty. It also goes without saying that a most complete general history should be recorded from each patient.

Physical Examination

A complete examination is of utmost importance. Everyone is aware that the arterial supply to the extremities is altered by many factors beside local pathology. The pulse in an extremity of a patient with systolic hypertension and aortic insufficiency is bound to be much different than in a patient without valvular defects and with a marked hypotension. Aside from the vascular system, endocrine disturbances, malignancies and maldevelopments may account for impaired arterial supply. These are only a few examples of conditions one must be on the lookout for in the general examination.

Extremities should be examined comparatively in the horizontal, dependent and elevated positions. The cardinal signs of rubor on dependency and pallor on elevation can only be noted with such postural changes. Trophic changes of skin, muscle and subcutaneous tissue as well as nail and hair growth should be observed and the two corresponding extremities compared. Temperature changes by palpation at various levels of an extremity should be noted and compared to the opposite extremity. Measurements should be made at corresponding levels and pulses should be palpated at accessible locations; in the upper extremity—

in the axilla, antecubital area and at the wrist on the ulnar and radial sides; in the lower extremity – at the groin, popliteal space, behind the internal malleolus and over the dorsum of the foot. The abdomen should be examined for iliac or aortic pulsations when femoral pulsations are not felt.

Although the diagnosis of occlusive arterial disease should be made by a careful history and physical examination, certain laboratory aids are indicated in each diagnostic workup. A urine analysis, complete blood count, sedimentation rate, hematocrit, blood sugar and Wassermann are basic. Other tests may be done if indicated. An x-ray of the extremities showing calcification of arterial walls aids in the diagnosis of arteriosclerosis – a normal film does not eliminate this disease process. Specialized procedures must be applied as indicated but are not a necessity in every routine study. The two most valuable aids are oscillometric studies and vasodilatation tests. They both may be misleading and like any other diagnostic procedure their interpretation in view of other clinical and laboratory findings is important.

The oscillometer may give positive information where the palpating finger fails to do so. It may locate pulsations missed otherwise. It is of value in comparing corresponding areas of extremities and in noting changes following vasodilatation tests. However, comparison readings are useless unless the patient is examined under the same basic conditions and in the same position. Blood pressure should be noted at each testing period. The method of application of the cuff may alter the readings and variations of the amount of subcutaneous tissue affect the degree of pulsation.

Vasodilatation tests of many types have been described. The original test of measuring peripheral skin temperature following the induction of elevated body temperature by the intravenous use of typhoid vaccine gave a very good estimation of the vasomotor index.[4] Reflex methods of inducing peripheral vasodilatation are easier on the patient and give satisfactory results. Paravertebral nerve blocks give a more rapid method of testing but there is always the possibility of an unsatisfactory block. They do, however, usually permit a comparison study of the two sides. Caudal anesthesia is of value in eliminating vasospasm bilaterally and of the distal parts of the extremities. Spinal anesthesia gives a higher level of vasodilatation but may drop blood pressure to a degree where it affects peripheral blood flow. The sympathetic block-

ing agents unless injected intra-arterially are of little assistance because of their generalized action.

In summarizing these vasodilating procedures I believe it wise to rely on more than one method in studying any specific case, particularly if the results of one test do not fit the clinical picture.

In interpreting the results of such tests various criteria have been suggested – originally[4] a rise of 6 degrees Fahrenheit was thought to be necessary if satisfactory results from a sympathectomy were to be expected. More recently some surgeons have gone so far as to state that even when there is no rise in peripheral skin temperature following such procedures, satisfactory clinical results can be obtained from division of the sympathetic preganglionic fibers. I personally believe that a clear cut rise of from 2 to 4 degrees Fahrenheit must result from these tests in order to expect improvement from vasodilatation procedures. The degree of rise will depend on such factors as the temperature level of the control period, the duration of the test, the relaxation of the patient as well as on the relative vasospastic and organic changes in each case.

One could detail numerous other tests devised to measure the degree of circulation in an extremity but such is not the purpose of this paper. They play only a small role in evaluating each case. Aortograms, arteriograms, various circulation time studies, especially the fluorescein test, the use of isotopes, and methods of measuring claudication are all helpful but as a rule complicated and not necessary in the evaluation of the usual case of peripheral arteriosclerosis.

Management

When one has thoroughly studied a specific case of occlusive arterial disease he must plan a regime of management to fit that case – such a program may have to be intensive and emergency in nature where the shut-off has been sudden or rapid in its development and it may be conservative in the slowly developing process of occlusion. In the latter case adequate collateral circulation frequently develops spontaneously so that the patient notices improvement without therapy. Moreover, if the problem is complicated by other vascular manifestations or other disease a more detailed outline of management will be necessary.

While many of you listening to this presentation may be expecting the description of some new procedure or the details of the use of some new drug, I shall have to disappoint you. In the remaining part of this

discussion I shall attempt to discuss the various modalities of available therapy and to evaluate each in proper aspect to the others in a regime of management. In any one case four main factors determine the outcome. First, can the primary process be arrested? Second, can collateral circulation be developed to an adequate degree before the main blood supply is occluded? Third, can infection and trauma be prevented in the tissues with deficient blood supply? and fourth, what means can be utilized to prevent thrombosis? In the first instance I know of no method of arresting the progression of occlusive arteriosclerosis as can be done in thromboangiitis obliterans where the cessation of the use of tobacco appears to stop the progress of this occlusive disease. Proper diet may have some effect in delaying its progress. A better understanding of the metabolism of cholesterol and the lipoproteins is leading us to eliminate certain fats. Lipotrophic substances may play a role in averting this disease, but recent papers are not too encouraging from this standpoint. In the second, third, and fourth instances a program of management is developed in an attempt to accomplish these results, i.e., increase collateral circulation and prevent infection and trauma and thrombosis. In order to accomplish these aims certain basic principles of management must be understood and correctly applied.

Rest Versus Activity: In the acute or far advanced occlusive process with rest pain, rest is imperative almost as much so as in the patient with an arterial shut-off to the myocardium. It must be complete as far as walking is concerned, until all vascular rest pain has cleared. However, when the process is early and in cases without rest pain then use of the extremities within their vascular capacity is the best method of stimulating collateral circulation. Activity, however, must be limited to that possible without the production of intermittent claudication. Once this symptom has occurred vasospasm of the normal or relatively normal vessels probably takes place leading to further thrombosis. It is not an uncommon story that a person develops an acute exacerbation of his pathology after trying to force walking against claudication symptoms. Train your patient to walk slowly and walk frequently but to limit his distances to those he can do without distress. Many patients can walk three to four times as far at 90 steps per minute than they can at the usual 120 steps per minute.[5] They can walk further on the level than up inclines, or when not burdened by carrying heavy objects. Their claudication distance is less on hard pavement than on turf.

Temperature: Various extremes of local environmental temperature have been advocated in the management of occlusive arterial disease. Originally high temperatures induced by infra-red lamps, heated cradles and diathermy or short wave were applied to stimulate circulation. It was soon noted that with such elevated temperature levels, burns, gangrene and deep tissue necrosis occurred and on careful study it was shown that with impaired arterial supply the increased metabolic needs of the tissues could not be met. The pendulum then swung to the opposite direction and extremely low temperatures were used. These were found also to be detrimental as they induced vasospasm and occasionally gangrene by freezing. Today we believe that average room temperature is probably the most logical level, but that self-generated heat should be maintained by soft non-constricting warm protective padding, clothing or covers.

Position of Extremities: An optimum position of the extremities with arterial impairment on an organic basis is most necessary. All too frequently extremities with impending or actual gangrene have been elevated above heart level adding to the ischemic state of the tissues by drawing the blood from inelastic vessels. On the other hand the patient himself frequently indicates the logical position by dropping his legs over the side of the bed in order to get relief from his rest pain. In severe cases the patient may sleep in a chair in order to rest at night. However, he usually overdoes this factor by keeping the legs dependent too long and increasing venous and lymphatic stasis, thereby complicating the problem.

The most ideal position is probably one with the extremities somewhat below heart level.[6] This can be accomplished by elevating the head of the bed on shock blocks, the degree being determined by several observations. In cases with severely impaired circulation and no venous or lymphatic disease, a fairly marked dependency should be used. When varicosities are present then less marked dependency or even a level position may be optimum. Any position producing edema or marked rubor or cyanosis is too low; and any position producing pallor is too high.

Protection of Extremities: I shall mention this angle but briefly although it is very important. In skin with impaired arterial supply even slight trauma, mechanical, thermal or chemical may precipitate necrosis. One must be particularly careful of heel pressure in a patient confined

to bed. Sunlight and artificial ultraviolet, strong antiseptics and the application of acids must be avoided.

Avoidance and Treatment of Infections: Many cases of gangrene develop as a result of infection. Tissue destruction may be the result of fungus or bacterial invasion. Following poor chiropody a break in the tissue at nail margins or in the area of calluses may be the portal of entry for bacteria. A fungus infection of the skin, benign and unnoticed in the webbing between the toes, often is the original site of gangrene.[7] Therefore careful hygiene of the skin with daily soap and water baths followed by careful drying between the toes is of utmost importance. If a fungus is present or suspected daily soaks in a mild fungicide solution such as 1 to 5000 potassium permanganate are indicated. The toes should be separated by some small firm objects during the soaks to permit the solution to come in contact with the web areas. In addition some of the mild fungicide powders should be used twice a day between the toes and in the shoes, especially if there is much sweating of the feet. Such therapy should be given both feet. If there is any allergic response to these medications, they should be immediately discontinued because the resulting skin lesions may become sites for infection.

Bacterial infection should be treated early and intensively. Locally, careful, frequent debridement of the area should be done to expose all of the involved area to the air. Only dead tissue should be removed. Ointments covering infected areas should be applied sparingly and with a water soluble base and not with an oily base. They should be removed daily and replaced. In many instances, normal saline compresses to keep the tissue soft and to avoid crusting are the applications of choice and each individual needs careful watching with solutions applied only long enough to accomplish this without causing necrosis. When infection has been controlled then tissues should be left dry and dead tissue allowed to separate from healthy tissue.

Antiseptics and antibiotics are seldom of value when used locally; their oral or parenteral use is indicated provided local skin reactions do not result. For this reason penicillin must be used with caution. The blood levels should be high since with deficient local blood supply the involved area will not receive adequate amounts of the agent. Those antibiotics which may be used intravenously have been injected into the arterial supply of the involved extremity when the major vessels are

patent, in this way getting a greater concentration of the agent to the desired area.

One word of precaution should be given regarding the possibility of the mold types of antibiotics activating an underlying fungus infection. If such occurs they should be discontinued or adequate fungicidal therapy used coincidentally. The sulfa preparations may be found to be safer and as effective as the mold group of antibiotics.

Elimination of Factors that Reduce Blood Supply: It is apparent that all mechanical factors, that by pressure on blood vessels impair circulation, should be eliminated. In addition vasospastic substances should be avoided. Tobacco being a marked vasoconstrictor should be completely eliminated and such drugs as adrenalin, epinephrin and ergot avoided. Pain can cause a high degree of reflex vasospasm and its control is a major problem in the management of these cases. Opiates give little relief from the pain of vascular gangrene and because of the long duration of therapy their use should be kept at a minimum. Many of the procedures already outlined will reduce the pain factor, and of all drug therapy, the use of alcohol in the form of whiskey or brandy together with salicylates seems to produce the best analgesia. One ounce of whiskey and ten grains of aspirin often will relieve ischemic pain as well as morphine or other narcotics.

Intravenous procaine has been advocated as a vasodilator. However, I believe that its chief effect is that of an analgesic and that any vasodilatation accomplished is done by eliminating vasospasm secondary to pain.

Vasodilatation: I approach this part of the regime with some misgivings. Various workers have described innumerable procedures to accomplish this all important process. Physiotherapy, drugs, mechanical appliances and surgery have all been advocated and used alone or together. I would like to emphasize that one should rarely depend on a single modality alone. If I should attempt to analyze each procedure or drug it would take many hours. I shall therefore try to give you my present concept of certain general procedures of value in increasing peripheral vasodilatation. There are two reasons to increase blood supply. First to supply the muscles with more blood in order that walking distances may be increased and secondly, to increase blood supply to the skin to maintain its integrity. Although there is some dispute regarding the sympathetic innervation of these two blood supplies it is

more commonly believed that the sympathetic control is most marked to the skin vessels and that muscle blood supply is not affected to any degree by sympathetic nerve blocking. It is my clinical impression and such is largely substantiated by numerous workers that little can be done from a vasodilatation standpoint to increase blood supply to the muscles and that we must depend on the use of these muscles as a stimulus for the development of collateral circulation.

However, the usual total disability of a patient with peripheral arteriosclerosis starts with tissue breakdown in the skin and here vasodilatation can be frequently accomplished to a most satisfactory degree. The warm dry skin after a lumbar sympathectomy is proof of this.

From a medical standpoint, numerous orally or parenterally administered, so called vasodilating drugs have been developed and used in the management of occlusive arterial disease. Some of these have been claimed to have a more pronounced effect on the sympathetic supply to the lower extremities than to that of the upper extremities. Within the last two years many investigators have reported that such therapy not only is frequently valueless but more often tends to rob the involved extremity of its total blood supply in order to fill dilated healthy vessels in other parts of the body.[8] There are still many that do not agree with this statement. There are also other reasons for not using these drugs systemically since annoying side effects from visceral action often prevent their use and drops in blood pressure interfere with their value.

If vasodilatation is to be obtained from drug therapy it should be the result of the application of the drug so that its maximum effect is to the blood vessels in the involved extremity. Thus procaine injected paravertebrally blocks the sympathetic supply to the desired general area. The same is true of the intra-arterial use of drugs such as histamine,[9] Priscoline, and Etamon. Mecholyl may be used to promote local vasodilatation in limited areas by applying it through the principle of iontophoresis.[10]

Mechanical Therapy: Various types of apparatus, such as the oscillating bed, suction pressure boot and intermittent venous occlusion apparatus have been developed to assist in the management of occlusive arterial disease. The various types of oscillating beds probably have the greatest value in that they utilize gravity to fill and drain partially obstructed arteries with stiffened walls. Gravity with the extremity depend-

ent may also force some vasodilatation to add to this effect. However, their value has been clearly demonstrated. In order to accomplish satisfactory results, these beds should be so constructed that the patient is comfortable, that they operate quietly and are easy of adjustment. This latter quality is essential as a bed must be capable of being adjusted to the requirement of each individual. The period of elevation should be just long enough to produce a slight blanching and the period of depression sufficient to allow good filling of all vessels with the accompanying state of rubor as evidence.

Intermittent venous occlusion is said to work on the principle that if the venous return is occluded for a period and then released that during the period of free flow more arterial inflow takes place as a compensating mechanism and that this is accomplished through a reflex vasodilatation. Diligent workers in this field claim good results from this procedure although there are many that feel that the clinical results are doubtful.

Suction pressure apparatus was one of the early forms used in the treatment of impaired circulation to an extremity. Its principle is sound but its application difficult and therefore this procedure has largely been discontinued. For its success there must be adequate major vessel supply distal to the retaining cuff; the cuff must fit snugly but not tight enough to act as a tourniquet and rather constant attention by a technician is necessary to keep the operating conditions satisfactory. The periods of pressure and suction and the degree of each should be adjustable and fitted to each case.

Another method of physiotherapeutically handling this problem is by the utilization of reflex heat. Placing the arms in hot water, using heat pads on the body or heating the abdomen with various types of electric wave therapy are sound procedures to produce vasodilatation.

Anticoagulants: If thrombosis in the arterial tree can be prevented and complicating venous thrombosis avoided then we have accomplished a great deal in giving collateral circulation a chance to develop. By promoting as rapid a blood flow as possible, avoiding periods of vasospasm, avoiding trauma and by maintaining hydration the tendency for thrombosis is reduced. Blood dyscrasias, especially polycythemia, must be recognized and coincidentally treated.

With the available anticoagulants we also have a means of handling this problem. I doubt if every case of peripheral arteriosclerosis should

be given an anticoagulant, but I do believe that all acute arterial thromboses (and emboli) should receive a combined heparin-Dicumarol regime and that such a regime should be continued until the patient is ambulatory. Patients put to bed for several weeks' bed care because of impending gangrene should receive anticoagulant therapy especially as a prophylaxis against venous thrombosis, which would complicate the local problem and be a possible site of pulmonary embolization.

In the acute case heparin should be given, preferably in saline form, subcutaneously, every 3 hours in doses adequate to double or triple the control clotting time. When the coincidentally administered coumerin derivative (Tromexin, Dicumarol, etc.) has elevated the prothrombin time to 2 or 2½ times its normal level, the heparin is discontinued. Initial doses of Dicumarol average 300 mgm. and of Tromexin 1500 mgm. followed by daily doses of 1/2 or 1/3 or less of the initial dose. Daily prothrombin times are a must. Some investigators have advocated much larger initial doses to be followed by a smaller dose days later when the prothrombin time begins to drop.

Accessory general therapy should not be overlooked. Tissues with impaired blood supply receive deficient amounts of food substances and vitamins. The diet therefore should be high in protein and in sugar (if no diabetes is present) and accessory vitamins added. Vitamin C in large doses is necessary to maintain capillary wall integrity and Vitamin B complex for its effect on nerve nutrition.

Obesity must be corrected by regulating the calorie intake. Endocrine deficiencies should not be overlooked as a patient with hypothyroidism needs thyroid to increase the circulation rate. The vasomotor instability of the climacteric period should be controlled by the proper doses of estrogens or androgens.

While Dr. Lord,[11] who will follow me tonight, will go into the surgical aspects of this problem you might like to hear a medical man's brief opinions of some of the surgical procedures. These are as follows:

Sympathectomy should be utilized in patients needing increased blood supply to the skin of extremities with gangrene or symptoms of marked ischemia. Such patients should show a vasospastic state with an ability to vasodilate. It is not a method of treating intermittent claudication and it will not reverse the process of arteriosclerosis as one outstanding surgeon has stated.

Aneurysms, involving arteriosclerotic vessels in the periphery should

be surgically treated.

In cases of localized thrombosis of major arteries associated with a marked vasospastic state arterectomy is indicated. The possible use of an autogenous vein transplant or the use of an arterial segment from a bank must be considered in locally occluded areas.

Amputation should not be delayed where it is evident that a gangrenous process is extending and cannot be controlled by the above medical and surgical procedures.

Summary

One may ask how he is to determine which of the above procedures to utilize in the management of an individual case. Such choice of a regime must depend on a careful study of the problem. On one extreme simply the proper use of the legs with general advice as to the care of the extremity may be entirely adequate. On the other hand acute or advanced cases need hospital care with the application of as many of the discussed procedures as are available and can be easily correlated.

I would like to stress the point that it is extremely difficult to evaluate any one procedure in the management of occlusive arterial disease. As already stated spontaneous improvement frequently occurs as collateral circulation develops and too frequently some modality of therapy is given credit. This fact would perhaps account for the numerous methods which have been advocated in the control of this disease process.

Conclusions

1. The patient must be treated and not alone his extremity.
2. A proper understanding of the underlying pathology is important.
3. Each case must be thoroughly studied before a regime is outlined.
4. Cooperation between the medical man and the surgeon is important.
5. The successful management of each case depends on the outlining of a regime embodying the indicated modalities of therapy.
6. Drug therapy, from the vasodilating standpoint, plays only a small role in the management of most cases.
7. The more acute or advanced the process the more intensive the regime should be, many cases needing hospital care.
8. The regime for each case should include the treatment of associated problems such as arthritis and obesity.

9. The prognosis of this disease is not as grave as it was once thought to be.

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THE SURGICAL THERAPY OF ACUTE AND CHRONIC ARTERIAL OCCLUSION*

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THE therapy of acute arterial occlusion is determined not only by the pathogenesis of the arterial block, but also by the setting in which the episode takes place. As is so often the case, proper therapy rests squarely on an accurate diagnosis which must be made as a rule by the clinical appraisal of the patient.

In general, there are four causes for a sudden block in an artery: 1) embolic; 2) thrombotic; 3) traumatic; 4) spasmodic. Let us consider briefly each of these causes.

An embolic occlusion of an artery may have had its origin in the left auricular appendage of a patient suffering from mitral stenosis and chronic auricular fibrillation, usually an individual under fifty years of age, predominantly female. The second group of patients who may embolize from their hearts are those with myocardial infarction and an associated mural thrombus. This group is usually beyond fifty and predominantly male. Finally, an occasional patient will manifest an embolic episode from a thrombus originating in an arteriosclerotic abdominal aorta or from an aneurysmal sac. The second important cause of an acute arterial occlusion is the thrombotic episode occurring suddenly in an individual with an advanced arteriosclerotic process in which an intimal plaque has ulcerated and served as the nidus for thrombus formation and blockage of the arterial blood flow. Usually these patients are above fifty and manifest generalized arteriosclerosis. An accurate differential diagnosis between an acute thrombotic occlusion and an embolic process may be impossible in some patients of this type. Thirdly, the traumatic occlusion of an artery may occur as a result of a bullet, knife wound, fracture with laceration of the vessel or may occur in the operating room usually as a result of a surgical error, although

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occasionally the artery may be deliberately ligated for purposes of resection of a malignant tumor. Diagnosis in this group is usually simple providing the peripheral pulses are carefully palpated in the involved as well as in the normal extremity. Finally, an acute arterial occlusion may be entirely on a spasmodic basis which in some cases may simulate an organic block and can be equally disastrous. One of the clearest examples of this type of spasmodic block of an artery is seen in the acute massive venous occlusion so ably described by Haimovici[1] and Veal and his associates.[2]

The therapeutic management of an arterial occlusion may be operative or non-operative depending on the diagnosis and other related factors. In Group I, the embolic cases, ideally an embolectomy should be performed in the younger patients (under 50) if seen within ten hours of onset, if the artery obstructed is the aorta, iliac or femoral artery, and if the general condition of the patient is such that an operative procedure is tolerable. The comprehensive management of such a patient follows: V. McC., a 44-year-old white woman was a known rheumatic with mitral stenosis and auricular fibrillation and had been subject to several bouts of cardiac decompensation. On January 25th, 1951, she suddenly experienced paralysis of the legs followed shortly by low back and upper thigh pain. Dr. Wm. T. Foley saw her within one hour of onset, diagnosed a saddle embolus of the aorta (no femoral pulses, cold, white legs, and absent sensation in the feet), and admitted her to the New York Hospital. In addition to the aortic embolus, pulmonary edema had developed. This was managed by a supplementary dose of digitalis, aminophyllin, oxygen and morphine. Under continuous spinal anesthesia, which has the multiple benefits of abolishment of the sympathetic tonus to the lower extremities, and contracting the intestines with relaxation of the abdominal musculature, the aortic bifurcation was exposed through a left rectus muscle-splitting incision. Following the isolation of the aorta and the common iliac arteries, an arteriotomy was made in the right common iliac artery within 1 cm. of its origin. The embolus was removed, the incision in the artery closed with an everting mattress suture of 5-zero silk and the posterior peritoneum carefully closed over the vessels. Recovery was satisfactory, the patient being discharged from the hospital on the 17th postoperative day in good condition. Two months later, catheterization studies were performed by Drs. Charles T. Dotter and Daniel S. Lukas. The findings

FIGURE 1—CARDIAC CATHETERIZATION (V. McC. 44 Yrs. F.)

	Preoperative	*Postoperative*
Cardiac Output L./Min.		
Rest	3.78	4.57
Exercise	3.73	4.95
Pulmonary Artery Mm. Hg.		
Rest	57	45
	24	21
Exercise	76	74
	39	34
Pulmonary Capillary Mm. Hg.		
Rest	26	18
Exercise	34	32
Mitral Valve Area in Cm^2	0.70	2.35

were in keeping with a tight mitral stenosis. Therefore, on April 14, 1951, a left auricular appendectomy and commissurotomy were carried out with an excellent clinical result. The salient pre- and postoperative catheterization data are shown in Figure 1. In suitable patients with mitral stenosis, auricular fibrillation and embolic phenomenon, it would seem desirable to attack not only the embolus but also to rid the patient of the source of the embolus, usually the left auricular appendage.

In general, the contraindications to an embolectomy are: 1) patients with emboli to the upper extremity and those in the lower extremity from the popliteal artery down. Occlusion of an artery in the upper extremity seldom causes gangrene because of the rich collateral circulation while a block in the popliteal artery is usually associated with operative technical difficulties which outweigh the usual values of operative over non-operative management, which Dr. Wilbur Duryee has discussed in his presentation. 2) The age of the patient and his associated arteriosclerotic process makes unwise an operative removal of the embolus in the elderly for two reasons. First, the vessel is often sclerotic to a degree which predisposes to thrombosis post-arteriotomy, and secondly, there has usually been pari passu with the arteriosclerotic pro-

cess an increment in the efficacy of the collateral circulation so that sudden occlusion of the main artery may be better tolerated. 3) When the time lag between the onset of the embolus and the operation is such that early irreversible changes in the foot are present or local changes of adherence of the embolus to the vessel wall may lead to thrombosis following arteriotomy due to endothelial damage. The recent development of regional heparinization by Freeman, Wylie, and their associates[3,4] broadens the indications for embolectomy as far as the age and time factors go. A polytheme catheter is introduced into the artery above the arteriotomy incision and 50 mgms. of heparin in 500 cc. of 5 per cent glucose in water is allowed to run over a period of twelve to twenty-four hours. Heparinization may be continued for one to five or six days by this method without seriously altering the general clotting time. 4) The general condition of the patient including his cardiac status may preclude an operative procedure as too great a risk to life.

The ideal management of the patient with an acute thrombotic occlusion of a main artery is still conservative or non-operative. Thrombectomies with regional heparinization may occasionally be successful but are usually surgical exercises and the loss of life due to operative intervention probably overrides the infrequent success following surgical intervention under such circumstances. Fortunately, non-operative methods will lead to a favorable outcome in the majority of instances.

Acute arterial occlusion due to trauma occurs with sufficient frequency to merit planned consideration of its management which is successful in a high percentage of cases. Whether the injury to the artery has occurred, on the one hand, in the street, in an industrial accident or due to violence or, on the other, during a procedure in the operating room, time is the most important factor. From two to twelve hours is the golden period for repair of an arterial injury. The ideal in management is prompt arterial repair by direct suture or by an autogenous vein graft or a homologous arterial graft. Arteries which have been ligated during an aseptic operative procedure such as a hernioplasty or during a high saphenous ligation may well be reconstructed twelve to twenty-four hours following closure of the wound with a high expectancy of success.

The spasmotic type of acute arterial occlusion seen most frequently in massive venous thrombosis of the lower extremity is handled best by Veal's method of vigorous passive and active exercise of the leg with

marked elevation as soon after the onset as possible. The arterial spasm is relieved as soon as the venous block has cleared, usually a matter of one or two hours or less. Previously we have managed several cases satisfactorily by venous thrombectomy of the superficial femoral vein under spinal anesthesia followed by anticoagulants, elevation of the foot of the bed and massive warm compresses to the leg. However, Veal's method[2] is so much simpler that it warrants a thorough trial in this group of cases. Occasionally, spasmotic occlusion of an artery will follow a fracture or dislocation of a joint which is in close proximity to the vessel. A paravertebral or stellate ganglion procaine block and anticoagulants will usually suffice to abolish the arterial spasm following correction of the fracture or dislocation.

The surgical therapy of chronic arterial occlusion should, in my opinion, be limited to carefully selected cases, usually after a thorough trial with non-operative measures. In the surgeon's armamentarium there are several procedures which have been explored during the last five years, but only one seems to have a real therapeutic effect in properly selected cases, namely sympathectomy. When this operation is carried out indiscriminately and routinely on patients with chronic arteriosclerotic and thromboangiitic occlusive disease of the lower extremities, it has been disappointing and frequently without value. Conversely, in patients with *demonstrable* vasomotor tone of greater or lesser degree, then sympathectomy may effect a beneficial change sufficient to warrant its use. Both on the Fourth Surgical Division at Bellevue Hospital and in private practice, a good result following sympathectomy has rarely evolved when preliminary tests have shown no evidence of vasomotor tone. When possible, we have employed the cool environment of a constant temperature room at 68 degrees F. and have carried out a paravertebral block with 40 cc. of 1 per cent procaine. If a temperature rise in the toes was detectable or if a cyanotic hue changed to pink or if constricted veins over the dorsum of the foot became full, then we have evidence of some vasomotor activity. If the procaine block has not produced any objective change, then the patient is subjected to reflex heat, either by immersion of the hands and forearms in warm water or by a heating pad to the abdomen. Should any of the above changes occur in the foot, then we know that there is some vasomotor activity and that the procaine block was ineffectual. A sympathectomy, therefore, will be of value. On the other hand, when no objective change has occurred

with either maneuver, then a sympathectomy is clearly contraindicated.

Another situation where sympathectomy is useless is in the patient whose only complaint is intermittent claudication. Silbert and his associates,[5] Elkin and Cooper[6] and others have shown that sympathetic nerve block and sympathectomy do not increase muscle blood flow, in fact, may actually decrease it. Certainly the patient who would benefit from a sympathectomy because of skin changes in the foot or toes should not be deprived of the operation because of an associated intermittent claudication, but it should be clear to the patient and the physician that no improvement in walking distance will result per se from the sympathectomy.

Let us examine some of the other new and revived operative procedures discussed in the current literature as having value in the management of chronic arteriosclerotic occlusive disease. One of these, the so-called revascularization of the leg by the production of a three-limbed arteriovenous fistula has recently received favorable comment by Johnston and his associates,[7] and by Ruggiero and Winfield.[8] From 1900 to 1915, several reports were made about its possible effect on the circulation to the lower extremity and Bernheim[9] reported the follow-up of one patient in 1931 who had been subjected to quadrilateral arteriovenous fistula with prolonged (18 years) improvement. The principle underlying the use of this procedure is that the femoral vein can act as an artery supplying blood to the capillaries when the main artery has been occluded. It has been conjectured that the reversal in flow through the vein will lead to utilization of oxygen by the tissues as a result of reversal of flow through the capillaries. Several obvious defects are apparent, the solution of which may well be impossible. First, the venous valves offer either a temporary or permanent block to the reversed flow of blood and hence possibly to thrombosis. Secondly, the branches of the vein distal to its anastomosis to the artery may afford short-circuiting by-passes for the blood to return to the heart without reaching the peripheral capillaries. Thirdly, no evidence has been presented in either clinical or experimental material of an increased utilization of oxygen by the tissues of the distal parts of the extremity. Recently, Skinner and Parsons[10] reported on eight patients in whom they constructed a fistula in the femoral vessels of ten extremities with impending or frank gangrene in seven patients with arteriosclerotic occlusive vascular disease with and without diabetes, and one with thromboangiitis obliterans.

They found the operation to be of questionable value in only four limbs. Our experience with the procedure has been limited to some eight patients and in all but two it was of no avail. One patient has been lost to follow-up after three months of observation, and the single good result was obtained slowly over several months by averting frank gangrene in a 66-year-old man with impending gangrene of his toes and distal half of the foot. Six months later, a lumbar sympathectomy relieved the pain which had persisted in his toes. On the basis of the above experiences supplemented by unpublished data, one might safely conclude that the operation of creating a three-limbed arteriovenous fistula between the femoral artery and vein is one of dubious value and will need the presentation of further favorable experience with it before accepting the operation as an adjunct in the care of the patient with chronic occlusive arterial disease.

The operation of "scraping" the thrombosed artery, leaving a shell of media and adventitia has been popularized by Bazy.[11] The procedure includes isolation of the thrombosed artery from the point of occlusion distally as far as possible – usually the lower end of the popliteal artery, preservation of its branches, longitudinal incision throughout the length of the exposed artery, scraping the thrombus with the adherent intima from the lumen, then suturing of the entire arterial incision. During the operation and postoperatively for two to four days continuous anticoagulant therapy with heparin is necessary. Several unpublished studies have been made and some favorable results observed. We have carried out the procedure only three times but with disastrous results, one patient dying on the fourth postoperative day from hemorrhage and shock due to the heparin therapy, while the other two rethrombosed their arteries in three to six days. The operation is tedious and has the basic weakness of the fact that the arteriosclerotic process is usually extensive and progressive. Wylie and his associates[12] recently reported favorably on an improved technique, using fascia lata and regional heparinization in some cases. This method is certainly the most promising one to be devised for the thrombotic group of patients.

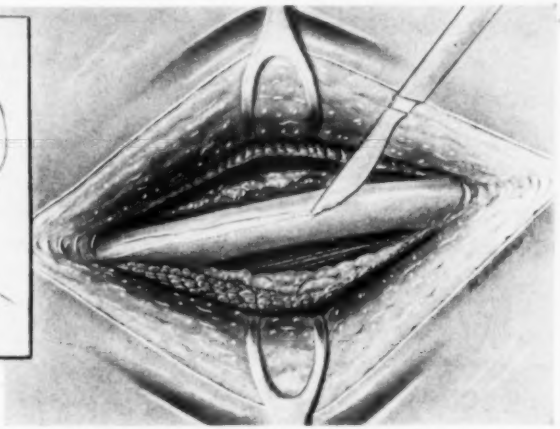
A third operative procedure which seems likely of greater successful application, although suitable cases are in the minority, is the resection of a relatively short segment of the thrombosed artery followed by insertion of an autogenous vein graft thereby effecting restoration of blood flow through the main arterial channel. Holden[13] described such a case with a satisfactory follow-up of four months. We had one clinically

ideal patient of 61 years in whom the arteriogram revealed a thrombosed three-inch segment of femoral artery in the middle third of the thigh. Moderately severe claudication had been the only complaint and a lumbar sympathectomy performed seven months earlier had been without influence on the patient's walking distance. The thrombosed arterial segment was excised and replaced by a vein graft from the accompanying femoral vein. The lumina of the proximal and distal arterial segments were cresenteric due to marked plaque formation. Postoperative anticoagulant therapy was discontinued after four weeks. The posterior tibial artery pulsated well for six weeks, whereupon it abruptly disappeared, suggesting a fresh thrombosis of one of the anastomoses or possibly elsewhere in the arteriosclerotic artery. Follow-up for five months shows that the patient's condition remains unimproved. Only with further experience will we be able to evaluate the operation described above. The patient stands little to lose because of the relative safety of the operation, but the important question is in what percentage will the procedure be successful.

Finally, the operation of arteriectomy has many proponents such as Leriche,[14] Schnayerson,[15] and others. It is based on the principle that a thrombosed segment of artery serves as the stimulus of the afferent arc to cause vasoconstriction through the sympathetics at local levels not affected by lumbar sympathetic ganglionectomy. There is no group of patients more difficult to evaluate a form of therapy than those with chronic arterial occlusion, and therefore, the efficacy of arterectomy is hard to judge. In three patients in which we have carried out this operation, no improvement was observed.

Before closing, I would like to describe an operative procedure which as far as I can determine is a new approach to an interesting group of patients suffering from temporary and sometimes permanent occlusion of the subclavian or axillary artery due to one or more of the shoulder-girdle syndromes. This procedure was evolved by Drs. Irving S. Wright and Robert Huebner and the author in a group of eight patients suffering from a combination of two or more of the following syndromes: hyperabduction, scalenus anticus, costoclavicular, with or without a cervical rib. Four of the patients had experienced complete occlusion of the axillary or subclavian artery after a period of intermittent occlusion associated with varying positions of the shoulder girdle and the arm, whereas the remaining four had exhibited only intermittent occlusion. In four of the eight patients, the condition was bilateral, two show-

Skin incision

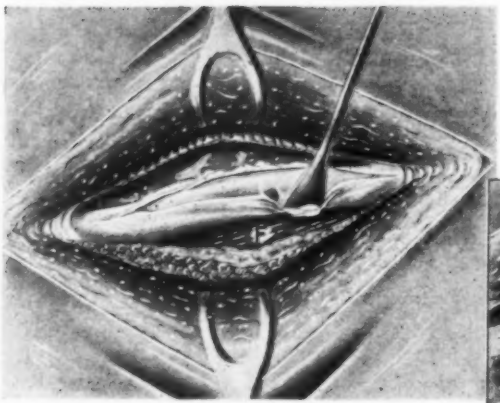


Incising periosteum to expose clavicle

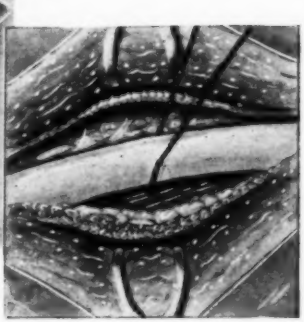
Fig. 2

ing bilateral occlusion while in the remaining two it was intermittent. Only one of the eight showed Raynaud's phenomenon. The reader is referred to an excellent review by Beyer and Wright[16] for a discussion of the diagnosis and non-operative therapy.

The operative procedure consists in total subperiosteal resection of the clavicle followed by removal of the periosteum, division of the scalenus anticus muscle and mobilization of the subclavian artery (Figs. 2-9). The results in eight patients with twelve involved upper extremities has been uniformly excellent in the follow-up of two to fifteen months. In those without thromboses, the radial pulse is strong in all positions of the arms and in those with thromboses, radial pulsation has returned in each extremity, although weaker than normal. In each patient, the symptoms of numbness, tingling, fatigue and pain have cleared and in one, prolonged ulceration of a finger tip healed rapidly (Fig. 10a and b). Full function of the arm remains and there has been no deformity of the shoulder girdle (Figs. 11 and 12). How wide the indication should be drawn for this operation must await further experience, especially after a longer period of follow-up of the early cases has been obtained.



Reflection of periosteum from clavicle; subclavius muscle (F)



Section of clavicle with Gigli saw

Fig. 3

Fig. 4—Removal of lateral segment of clavicle

Fig. 5—Removal of medial segment of clavicle

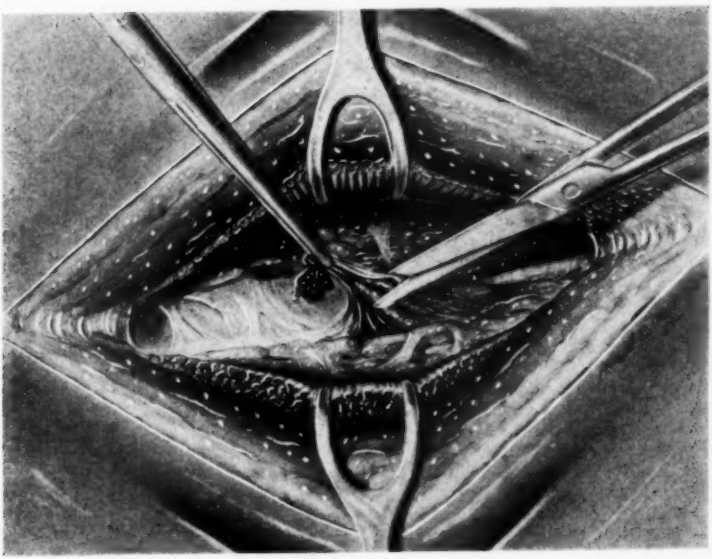


Fig. 6—Excision of periosteum from clavicle bed

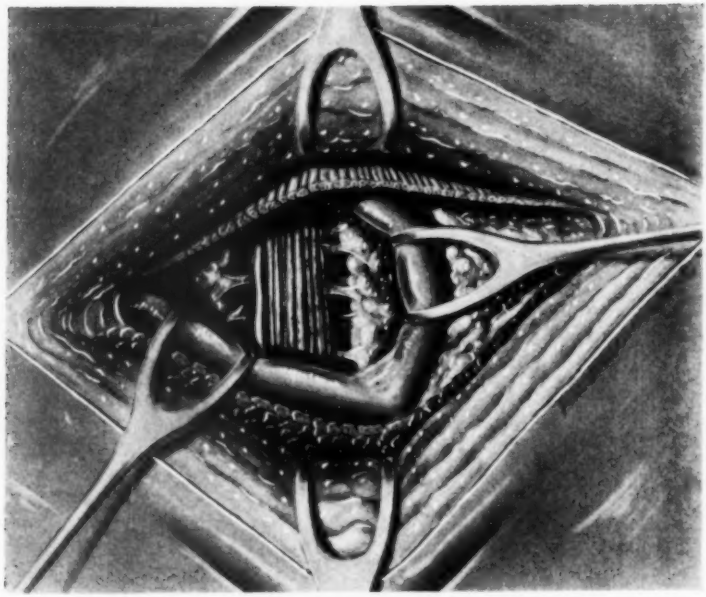


Fig. 7—Exposure of scalenus anterior muscle and phrenic nerve

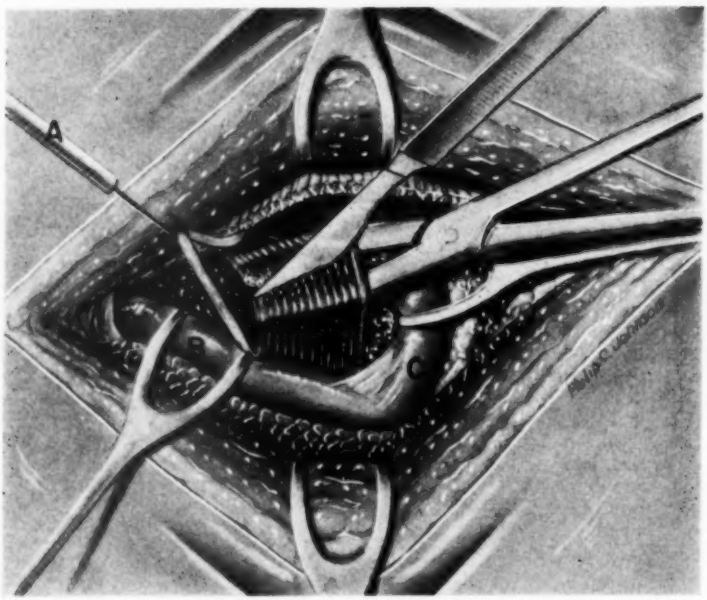


Fig. 8—Scalenus anterior muscle sectioned. Phrenic nerve (A), subclavian vein (B) external jugular vein retracted (C)

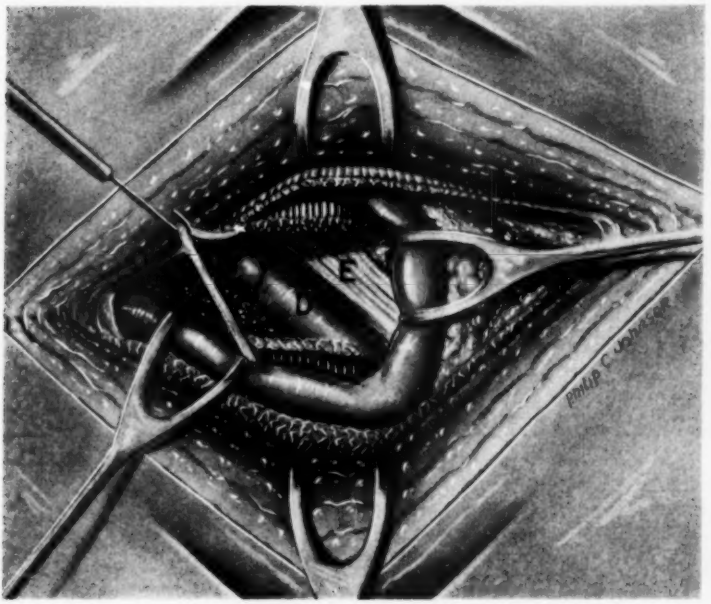


Fig. 9—Exposure of subclavian artery (D) and brachial plexus (E)

Summary

1. The four causes of acute arterial occlusion have been discussed from the diagnostic and therapeutic points of view. It has been stressed that the clinical appraisal is sufficient for the application of proper therapeutic measures. An attempt has been made to outline the indications for and contraindications to surgical intervention in each of these four categories of acute arterial occlusion.

2. The role of surgical therapy in chronic arterial occlusion has been critically evaluated and the need for the careful individualization of cases stressed. For the most part, a non-operative regime is the one of choice in the majority of patients. Newer forms of surgical procedures are still on trial and have not as yet made a significant inroad on the widespread problem of peripheral arteriosclerotic occlusive vascular disease.

Fig. 10A

Fig. 10B

Fig. 11

Fig. 12

3. A new operative procedure has been described which has shown uniformly good early results in eight patients suffering from two or more of the shoulder girdle syndromes of hyperabduction, scalenus anticus, costoclavicular, and cervical rib which had resulted in either temporary intermittent occlusion of the subclavian or axillary artery or in permanent thrombosis of the artery.

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REPORT ON FLUORIDATION OF WATER SUPPLIES

by the Committee on Public Health Relations*

The Committee on Public Health Relations has examined the available evidence relating to the fluoridation of water supplies for the prevention of dental decay, and has consulted with some of the leading authorities in this field. These include Dr. David B. Ast, Director of the Bureau of Dental Health of the New York State Department of Health, who has directed a study in Newburgh and Kingston, New York; Dr. H. Trendley Dean, Director of the National Institute of Dental Research, and Dr. Francis A. Arnold, of the Institute staff, Bethesda, Maryland; representatives of the American Public Health Association, the American Water Works Association, the New York City Bureau of Water Supply, the New York City Department of Health, as well as representatives of local dental societies and dental schools.

Reports of controlled experiments in which fluorides in the amount of 1 part per million have been added to city water supplies have shown after five or six years' trial that dental caries in children who have consumed fluoridated water is lower by from 40 to 60 per cent than in children in the control cities. Most of the studies were originally planned to continue over ten years, but the results have been considered so decisive that the control cities are demanding fluoridated water for their own children without waiting for the end of the experiment.

The American Dental Association reported July 1, 1951, that 102 communities in twenty-eight states were using fluoridation as of that date; fifty-three of these are in Wisconsin. Most of them are in small cities and towns.

Fluoridation of public water supplies has been approved by the U. S. Public Health Service, the American Public Health Association, the State and Territorial Health Officers, the American Dental Association, the State and Territorial Dental Directors Association, many state and local dental societies, and many departments of health. The New York State Department of Health recommended in March 1951 that all communities in the state add fluorine to their water supplies, and a few have already taken measures to adopt the procedure. In addition to these, a special committee of The National Research Council, after several months of study, has just issued a report approving fluoridation.

Several objections to fluoridation have been raised, and all have been answered by competent authorities. It is well known that fluorine ingested in large amounts is highly toxic and that a high fluorine content in drinking water will produce dental fluorosis, or mottled enamel. The investigators report that when the concentration of fluorine in drinking water is maintained at a level of 1 to 1.5 parts per million, the concentration which is effective in preventing dental caries, fluorosis will occur only in rare instances. It is then in a form not discoverable except by meticulous examination and not in the objectionable pattern of typical mottled enamel.

Objection has been made on the ground that the application of fluorides to water is mass medication; a bill proposing to authorize the addition of fluorides to water is reported to have been defeated in the California Legislature as a result of protests by the Christian Science Church. Fluoridation does not add anything that the most desirable type of potable water does not already contain, and the amount recommended is much smaller than the amounts being con-

* Prepared by a Subcommittee consisting of: I. Ogden Woodruff, Chairman, Alfred E. Fischer, Shepard Krech, Asa L. Lincoln, Harry S. Mustard, James R. Reuling, E. H. L. Corwin, Secretary.

sumed continuously by several millions of people in various parts of this country.

Interference with industrial processes employing large amounts of water is another possibility put forward as an objection. Such processes would include dyeing, the making of ice, baking, the handling of dairy products and brewing. The Committee has communicated with two large firms concerned with dyes, the Allied Chemical and Dye Corporation and the Dupont Company, asking whether the processes of dyeing are in their experience adversely affected. Both replied that they had no record of such adverse effects in their own installations, nor had they heard of any elsewhere. Difficulties were encountered in the manufacture of ice in Charlotte, N. C., but these were soon overcome by methods used to prevent cracking from other causes. Reports from other communities indicated that anticipated problems did not come to pass.

Reluctance to undertake the fluoridation of the public water supply of New York City has been expressed on the ground that the procedure would entail the addition of the chemical to the enormous volume of water used in the city, only about 5 per cent of which is ingested. The Committee is informed that in spite of the apparent waste, the fluoridation procedure is still the surest and least expensive method of preventing dental caries in the greatest number of children. The addition of fluorine to milk, salt or other foods is deemed impractical because of the variations in naturally occurring fluorides in various parts of the country and the resultant complexity in marketing.

Direct application of fluorides to children's teeth is widely practiced and is effective, but this method is entirely impractical for large-scale application. It must be done at least four times at intervals of two or three years; it must be done by a dentist or dental hygienist; and the cost in dental time is high as compared with the cost of fluoridation of water. The Health Department includes topical application in its program on an experimental basis, but so far it has reached only a small proportion of children.

The American Water Works Association advises that the cost of fluoridation will vary between 6 and 18 cents per capita annually. This wide spread is due to (1) the choice of chemical, (2) the type and number of feeding units needed, (3) the amounts of chemical purchased at one time, (4) the per capita use of water, and (5) the amount of fluoride occurring naturally in the water of the particular community.

There are two ways of introducing fluorine salts. One is by the use of a solution; the other employs dry materials. For large cities dry feeders are available; the "volumetric" type, which delivers a measured amount of dry chemical within a certain time period, and the "gravimetric" type, which delivers a measured weight of chemical in a given interval of time. The cost of a volumetric feeder is about $1,000 and that of a gravimetric feeder is about $3,600, depending on size and auxiliary equipment. Installation costs range from 10 to 50 per cent of the price of the feeder.

A routine system of inspection to assure the maintenance of the proper concentration of fluorides is essential. Safe operation requires supervision by proper public authorities.

Recommendations

1. Having weighed the advantages and disadvantages in the light of expert opinion, the Committee recommends that New York City be urged to proceed with the fluoridation of the public water supply as a measure for the prevention of dental caries.
2. Since fluoridation is not a cure for all dental ills, the Committee recommends that the dental health education and service program, including topical application, now carried on by the Bureau of Dentistry in the Health Department be continued for the care of those who have not had the benefit of this preventive measure in their early years.
3. An educational program to promote general acceptance of the program in the community is recommended to the Department of Health.

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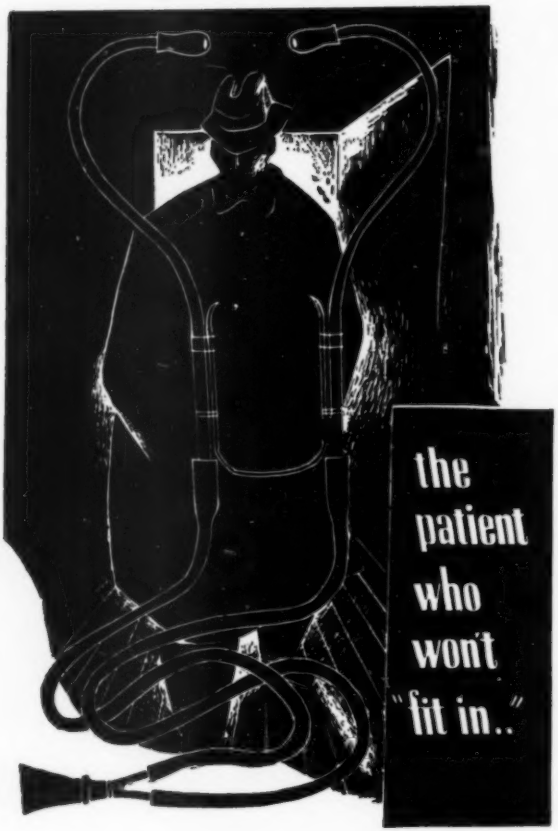

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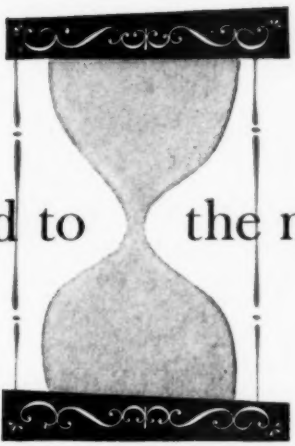

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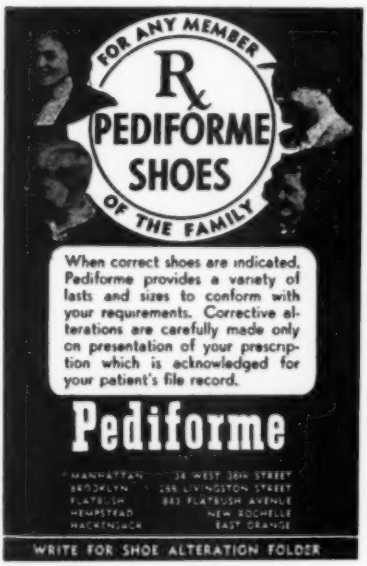
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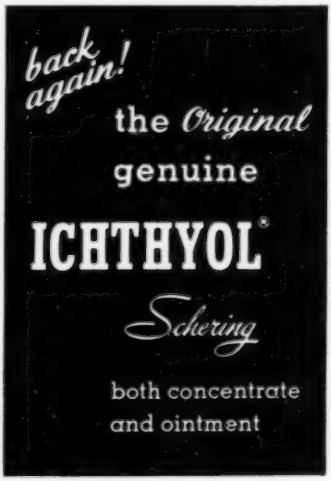

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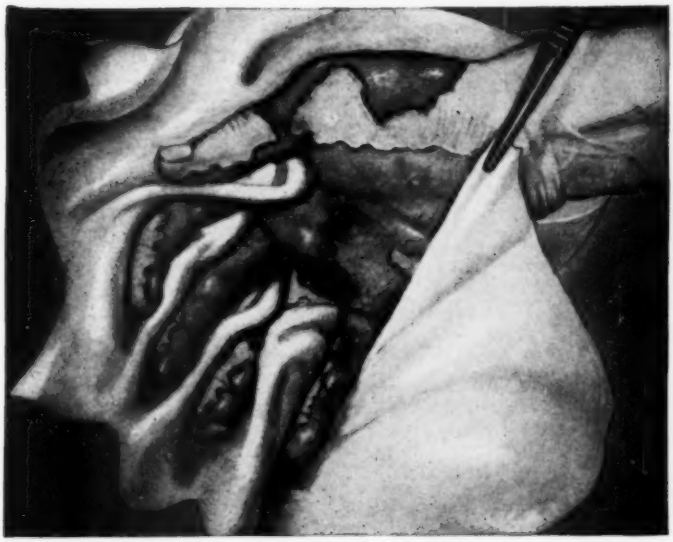

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(7½ gr.)	0.5 Gm.	with (¼ gr.)	15 mg.
*(3¾ gr.)	0.25 Gm.	with (¼ gr.)	15 mg.

THESODATE, POTASSIUM IODIDE AND PHENOBARBITAL

Theobromine Sodium Acetate	(5 gr.)	0.3 Gm.
Potassium Iodide	(2 gr.)	0.12 Gm.
Phenobarbital	(¼ gr.)	15 mg.

Capsules also available in forms marked with asterisk (*) above in bottles of 25 — 100.

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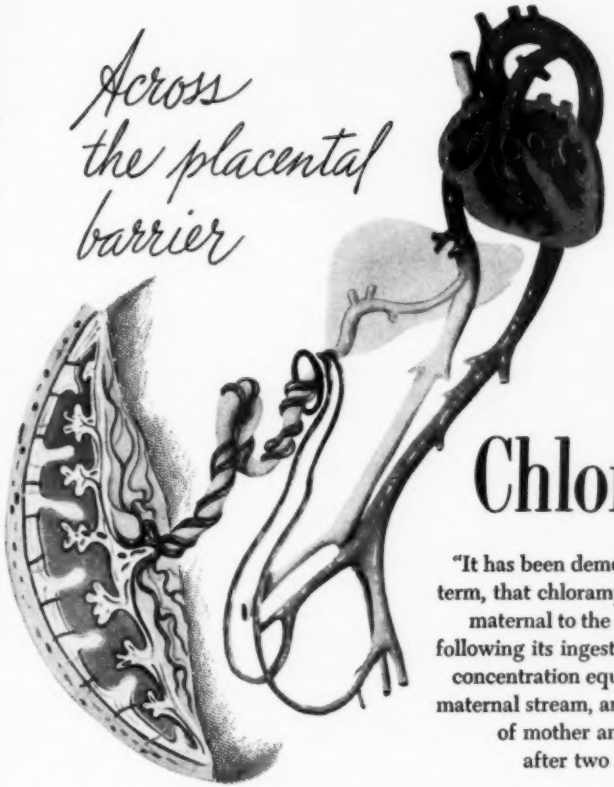

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Bibliography: (1) Stevenson, C. S.; Glazko, A. J.; Gillespie, E. C., and Maunder, J. B.: J.A.M.A. *146*:1190 (July 28) 1951. (2) Scott, W. C., and Warner, R. F.; J.A.M.A. *142*:1331 (April 29) 1950. (3) Ross, S., and others: J.A.M.A. *142*:1361 (April 29) 1950.

CHLOROMYCETIN is supplied in the following forms:
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*Wilbur, D. L.: Principles in the Use of Vitamins in Treatment: I. Vitamin Deficiency Diseases. Gastroenterology, 1:179, Feb., 1943.

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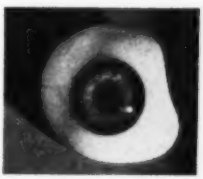

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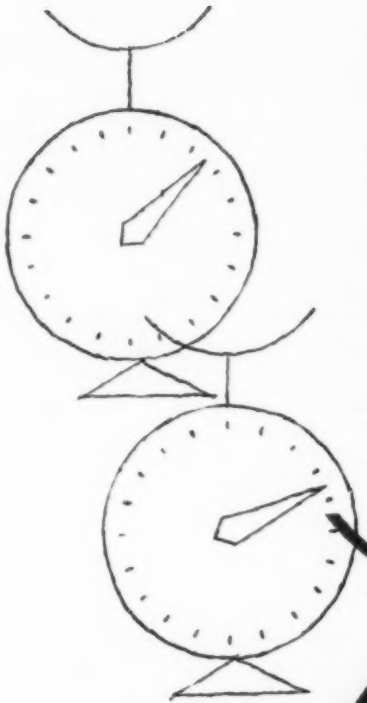

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1 Gardner, L. I., Butler, A. M., et al.: Pediatrics 5:228, 1950
2 Nesbit, H. T.: Texas State J. M. 38:551, 1943
3 Bull. National Research Council No. 119 Jan. 1950
4 Recommended Daily Dietary Allowances, Revised 1948, Food and Nutrition Board, National Research Council

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APRIL 3

1. INTRACAPSULAR HIP FRACTURES—David Bosworth, *Attending Orthopedic Surgeon, St. Luke's Hospital*—Philip D. Wilson, *Surgeon-in-Chief of the Hospital for Special Surgery*—Arthur Krida, *Consulting Orthopedic Surgeon, St. Luke's Hospital, and to the Hospital for Special Surgery.*

APRIL 10

2. RECENT ADVANCES IN THE TREATMENT OF POISONINGS—A. W. Freireich, *Assistant Clinical Professor of Medicine, New York University Post-Graduate Medical School; Associate Visiting Physician, Bellevue Hospital.*

APRIL 17

3. THE BIOLOGY OF ETHICS—Ralph W. Gerard, *Professor of Physiology, University of Chicago.*

APRIL 24

4. DIET AND LIPOTROPIC AGENTS IN ATHEROSCLEROSIS—John W. Gofman, *Associate Professor of Medical Physics, University of California, Berkeley.*

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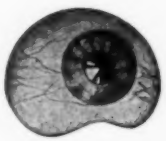

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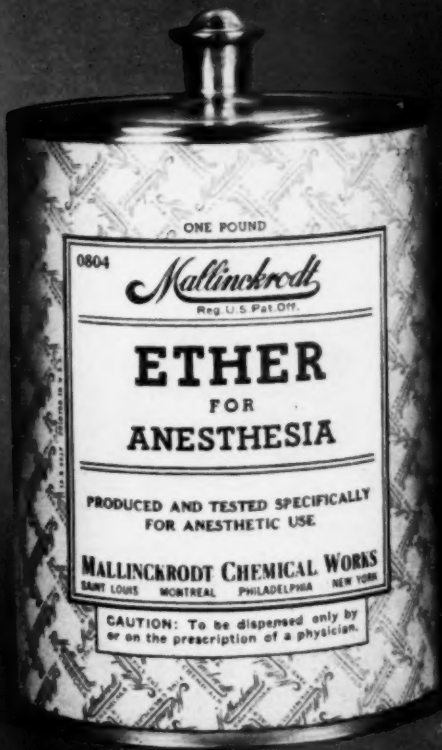

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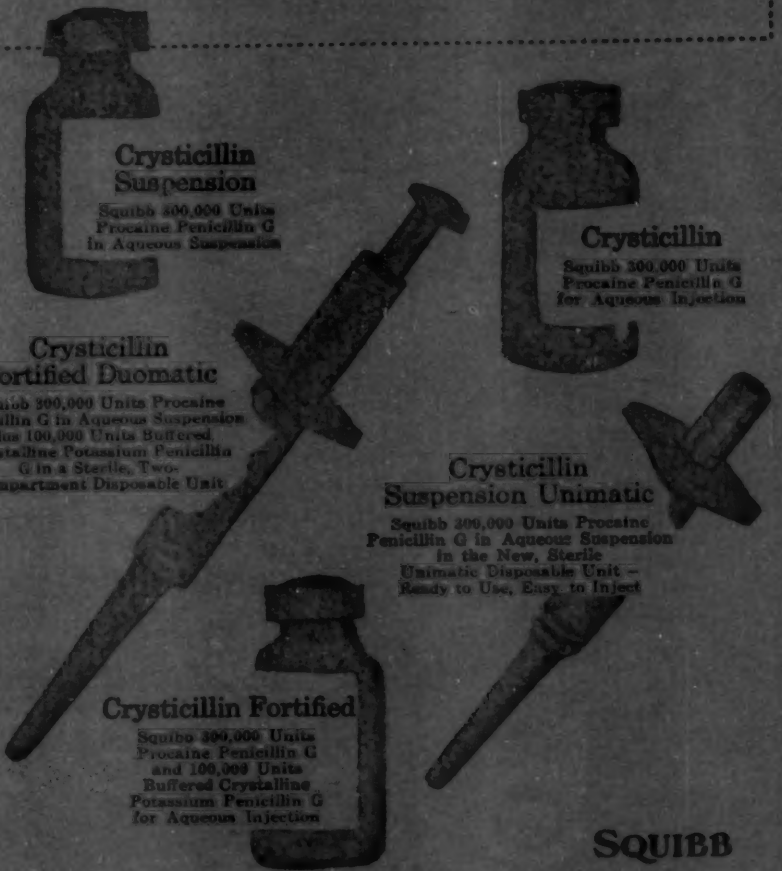

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